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THOUGHTS

ON THE CONNECTION

OF

LIFE, MIND, AND MATTER;

IN

Respect to Education

By J. P. BATCHELDER, M. D.

"The true conquests, the only [illegible] which do not cause a tear, are those which are gained over ignorance. The most honorable, as well as the most useful occupations of men, is to contribute to the extension of ideas." NAPOLEON.

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PREFACE

The design of the author, in writing and publishing the following pages, is to direct the attention of public teachers and others whose duties connect them with the education of youth, and of the public in general, should he be so fortunate as to reach the public mind, to those physiological principles, which, according to his view, constitute the very starting point at which all educational movements should originate, and to contribute something towards supplying a defect, which, it appears to him, exists in our systems of education. If he has failed in the execution of that design, he indulges the hope, that his humble labors will put some abler pen in motion, and consequently, be not wholly lost.

Early in his professional career, he was deeply impressed with the conviction, that a knowledge of physiology was as necessary to a correct understanding of the phenomena of disease, as those of health; and therefore, that all medical theories should be closely connected with, if not absolutely based on that science; which conviction induced him to study it with more than ordinary attention, and caused its principles not only to pervade most of his pathological reasonings, but influence, unduly perhaps, his metaphysical researches.

This circumstance led him in the first instance, to contemplate mental cultivation in the light of physiology, and finally induced him to connect its principles with those of education; the beneficial effects experienced in the education of himself, (for he is self-educated,) and others have fully satisfied him of the utility and importance of that connection; and as the culture of the intellect should commence in the nursery, and be carried on in the parlor as well as in the school or college, the subject commends itself to the consideration of parents, as well as professed teachers.

In considering this subject, he has from time to time, availed himself of information derived from various writers on physiology, both ancient and modern, and endeavored to make such use of it, as seemed best calculated to subserve the objects in view; but from his habits of reading and thinking, by which he has constantly essayed to make others thoughts and reflections his own, and to give them a tinge of originality in their passage through his mind, without regarding the sources whence they were derived, he is unable to make those acknowledgements of indebtedness, which may be due to particular authors; believing, however, that no writer on physiology of any note, whether ancient or modern, has been overlooked in his study of that science, he cheerfully acknowledges his obligations to all, but more particularly to Haller, Blumenbach, Soemmering, Richerand, Parry, Park, Bichat, Bell, Muller, and Carpenter. He also desires to express his obligation to several literary gentlemen, for their advice and suggestions; and particularly to the Rev. Professor Mandeville, of Clinton College, for his assistance in correcting his manuscript.

Unlearned in philology, and uninstructed in the rules of composition, the writer is forward to acknowledge, that in many instances, he has experienced (partly, he thinks, from the abstruseness of the subject,) considerable difficulty in expressing his ideas with a clearness, which has been satisfactory even to himself; but he trusts, that with the help derived, from the sources alluded to, his language has been made so plain, as to enable his readers to apprehend his meaning without much trouble. As a literary production, its pretensions are so few, and withal, so humble, that he supposes no one will open upon it the battery of criticism, by which it might be soon demolished; nevertheless, as truth is his object, he will not feel hurt, but gratified, if its faults, and especially its errors, be detected and pointed out, in the spirit of philosophic candor. The subject is important, and worthy of more extended discussion, than the author is able to bestow.

PUBLISHERS' ADVERTISEMENT.

This treatise is presented to the public, under the full conviction, that the subject, although one of the utmost importance to persons engaged in the education of children and youth, either as parents or teachers, is yet one, of which comparatively nothing is known.

The Author has long sustained a high reputation for extensive reading, and scientific research, and for the practical application of their results to the affairs of every day life. The views here presented, are the fruits of long and mature reflection, thorough investigation, and much practical experience as a teacher, and it is believed, that although some of them may be considered bold and original, they will be found to bear the test of rigorous examination, and the closest scrutiny. If we mistake not, many of the physiological views, will likewise be interesting to the medical man, as well as the general reader.

Utica, September, 1845.

THOUGHTS ON THE CONNECTION

OF

LIFE, MIND AND MATTER.

I have been long convinced, that the legitimate object of education, is not to give the pupil knowledge; but to teach him how to acquire it, how to employ the faculties with which he has been endowed. To do this, the instructor himself should be conversant with the laws by which the faculties are governed; which implies a knowledge of physiology, not possessed by many who have not been led by their professional pursuits to acquire it. Having been considerably employed in early life as a teacher in the public schools in New England, and for thirty-five years past, almost daily engaged either as a public or private instructor in teaching the science to which I am devoted, I have been induced to bestow some thoughts on the connection of life, mind and matter, and the laws by which they are governed in that connection, relatively to education. I am aware that the union of life, mind and matter, is a subject involved in great difficulty; that it has been considered by some, as among the arcana of nature, which science could neither unfold nor even reach. It may, therefore, seem presumptuous in me to attempt to lift the veil. But the man of science, however humble his pretensions, need not be deterred in his reach after knowledge, until he has arrived at that boundary upon which has been legibly inscribed the inhibition, "thus far shalt thou come and no farther." God cre-

ated matter for the manifestation of his own glorious attributes, and, that this manifestation might never cease, he has stamped it with the impress of perpetuity. Its existence depends upon his will alone; and in order to make it capable of such manifestation, it was necessary to endow it with certain properties which should rise in the scale of importance in proportion to the number of his attributes that he designed to illustrate. To display his power and wisdom only, it was merely requisite to invest it with those properties upon which the phenomena of mere matter depend, and from the exertion of whose energies may be inferred the physical laws by which those phenomena are governed.

These properties and the laws to which they give rise, are no less permanent than matter itself. The properties to which we now allude, are two only, viz: attractability and repulsability: and the endless forms and varieties which the phenomena of inanimate matter present are the result of two functions only: attraction and repulsion, which spring from the properties above mentioned. We are totally ignorant of the essences of these properties, because we are destitute of organs by which we can take cognizance of them.

For the manifestation of God's goodness, it was necessary to connect the vital principle with matter. Whether vitality exists, distinct from, and independent of matter, is beyond our power to determine; nor is it at all necessary that we should, because it is manifested to us in no other way than through the medium of matter. Connected with a substance whose properties, functions and laws are ever the same, the properties, functions, and laws of life as manifested through the instrumentality of this connection, are no less permanent and immutable than the connection itself. God's plan in regard to life, is no less simple than it is in respect to inanimate matter. The properties essential to vitality, are sensibility and mobility; and the essential functions growing out of these properties, are sensation and motion; by the modifications of which all the operations and phenomena of

life are performed and exhibited. From the study of these all its laws may be deduced.

To accomplish the design of manifesting vitality through the instrumentality of matter, organization was necessary; hence, all animated matter is organized. Organization, which is the act or process of arranging or forming the particles of matter into instruments of action, by which some operation is performed, or process carried on, or by the agency of which some design is accomplished, implies the existence of mind in the being who organized, but not in the thing organized; for vegetables are organized bodies, and are consequently endowed with that species of vitality which is connected with, or perhaps springs from organization; but they manifest no indications of mind: and why? Because God has withheld from the matter of which they are composed, organs by which it can be produced or manifested. Without such organs, organized bodies were capable of showing forth his power and wisdom in a higher degree, and in a more perfect manner than were the properties with which he had invested mere inanimate inorganic matter. For the manifestation of His goodness, it was necessary that matter should be invested with properties through which it might be affected by that goodness: otherwise, it could never give any evidence of the existence of that attribute. That matter should be capable of manifesting other attributes of God, such as his justice and mercy, it was necessary that mind as well as life, should in some way or other be connected with it; and it appears that vitality constitutes the connecting link between mind and matter. In what consists the essence of life or of mind we know not, and probably never shall, because the Creator has withheld from us the organs by which they can be recognized as separate and distinct existencies. We can take cognizance of them only through the medium of matter, and precisely in the same way as we do of gravitation, chemical affinity, electricity, etc. Whether they can indeed exist independently of matter, we can not for the reason assigned.

tell. All analogy, and the immutability of Deity warrant the belief that they have no such separate existence; and that a connection of some kind or other with matter will be as necessary for their manifestations in a future, as in the present world.* We think that inspiration fully maintains this view of the subject; for we are told by the Apostle, that we shall be changed; that this corruptible must put on incorruption, and this mortal immortality. When the last trump shall sound, we shall be all changed in the twinkling of an eye, and then our bodies refined and sublimated by that change, will rise "to be our house immortal and eternal." If life and mind do not exist except in connection with matter, and of course subject in a greater or less degree to its influence, of what vast consequence is it to us, and to all concerned in educating the mind, that we become acquainted with them in this connection, and with the laws by which they are governed! It is this importance of the subject with reference to education, which has prompted me to trace out and illustrate as far as I may be able, the laws by which life, mind and matter in connection, are governed. Although it might be interesting and instructive to trace the connection of life with matter from the vegetable, (destitute of mind) through the ascending series up to man, "creation's lord," yet as it is not closely connected with our subject we shall forbear, and proceed to remark that the human body is a machine formed by God himself, as an instrument for the manifestation of the phenomena of vitality and mind. As it is composed of matter connected with life and mind, it has been supposed to be necessarily governed by three different kinds of laws, viz: such as govern inanimate matter, such as govern life, and such as govern mind. Like other matter, it is, to be sure, obedient to the laws of gravitation, &c., but notwithstanding its com-

* Dr. Adam Clarke says. "God the uncreated Spirit manifests Himself by material substances. Created spirits must be manifested in the same way; and though matter may exist without spirit, and spirit without matter; yet, without the latter, spirit can not become manifest."

plexity of organs, and its trifold composition, we believe that no such complication of laws is necessary for the regulation of its movements. We have said that there are only two properties, sensibility and mobility; only two functions, sensation and motion, which result from the combination of life with matter, and that upon the various modifications of these, all the phenomena of life depend.* These properties and functions are common to every organ of the body, and of course the brain, the organ of mind, is as much under their control in the performance of its function, the production of thought, as the liver in the production of bile; and the laws by which the operations of the former, the brain, are governed are precisely the same as those by which the actions of the latter are regulated. The secretion of bile is performed by the capillaries of the liver; the production of ideas by those of the brain. The structure or organization of the liver is such, that if a certain portion of its capillaries act at all, they must secrete bile; in like manner, the structure or organization of the brain is such, that if a certain portion of its capillaries act at all, they must produce ideas, and can do nothing else, hence the uninterrupted flow of thought during our waking hours; with this difference, however, that we can (as will be seen) acquire an influence over the actions of the capillaries of the brain so as to make them produce such trains of thought as we please, while those of the liver go on forming bile independently of the will. [See Appendix.] The reason of this might be explained if required, by the drift of our subject. The doctrine we mean to promulgate is, that the production of thought and the operations of the mind, as function of the brain, are originated by the same causes, influenced in the same way, regulated by the same principles, and governed

* To carry out the analogy and simplicity of the design, we should say, metaphysically speaking, that the properties of the mind are two only, perceptibility and reflectibility; and that its functions were only two, perception and reflection; and that all the phenomena of thought depended upon the modifications of those two properties and these two functions.

by the same laws, as are all the other operations and functions of the body. In order to establish and elucidate this doctrine, it will be proper and necessary to show how the properties and functions of life, or of the living body are modified and governed; how changes of action are effected, and the laws by which they are governed: and to point out the causes by which those changes are produced, and the laws by which those causes are governed: and in conclusion, endeavor *en passant* to prove that all these modifications, actions, and changes of actions, and the causes by which those changes of action are effected; and the laws by which all are governed, are equally applicable to the production of thought, and emotion in the mind, as they are to the performance of function in all the other organs of the body. The two essential properties of vitality, viz: sensibility and mobility are so modified by structure, that every organ in the human body has a sensibility and mobility peculiar to itself, and therefore a mode of sensation and motion which can belong to no other organ of a different structure, consequently a function which no other can perform. This modification of vital properties and functions by structure is of a permanent character, and is, therefore, a provision of the Creator, and an illustration of his foresight, wisdom and goodness, to prevent the blending of the functions of different organs, and the confusion, which, but for it, must have ensued. The proof that the properties and functions of an organ are modified by structure, may be demanded. If, then, the same sensation in an organ or tissue be produced by a variety of causes other than the true physical cause, and in its entire absence, and indeed by mere change of action in the organ itself, and without any known or appreciable cause whatever, the inference, we think, is obvious and irresistible, that this sameness of sensation is owing to the peculiar structure of the organ which so modifies its action, that if it act at all, it must act in the same way, and consequently always produce the same sensation, and hence it is that there are, as

has been already hinted, no mistakes, no blending of functions in the system; each organ performing its own appropriate and peculiar function for the very best of all reasons, because it must do that or nothing.

The eye, for instance, is acknowledged by all to be the organ adapted to produce or experience the sensation of light, and this might be inferred almost a priori, by any one acquainted with its anatomical structure, and the laws of light, for it is a perfect optical instrument. A certain something emenating from a luminous body, and entering into this organ, produces a luminous appearance, which is termed the sensation of light.* This emenation is called light, and is the true physical cause of the sensation above mentioned; but it is a well known fact, that this luminous appearance in the eye can be produced by many causes other than the true physical cause, and indeed in its total absence, as by the galvanic shock: a blow on the eye, or even on the back of the head, by a fall on the ice, as most people can probably testify. This sameness of sensation from so many different causes, must arise from the peculiar structure of the organ, and is, therefore, a proof of the modification of property and function by structure.

The ear is the organ destined to produce or experience the sensation of sound, the physical cause of which, is the undulations of air impinging against the membrana tympani, or drum of the ear, as it is commonly called; but how often do we hear patients complaining of noises in the ear, which are produced by mere changes of circulation in some part of the auditory apparatus, in the entire absence of the appropriate physical cause, the undulations of air. These noises are frequently described by patients, saying that they resemble the rolling of carriages; the roaring of the wind;

* This emanation from the luminous body penetrates the eye, and falling upon the retina, causes a change in the circulation of that part, or, as some suppose, in the action of the vessels of the chorid coat, which change is perceived by the retina, and it is this perception of change, which, being modified by the structure of the part, constitutes the sensation of light.

the rushing of mighty waters, or the whizzing of steam from the tea-kettle. We often hear people complain of fatigue, a sensation peculiar to the muscles and experience it ourselves, when no exertion, the physical cause of that sensation, has been made.

We might go on and multiply proofs; but it is presumed that enough have been adduced to convince every one, that when the identical sensation has been produced in the absence of its legitimate physical cause, and by another altogether different in its physical properties, it must be ascribed to the fact that the structure of the organ, or part experiencing it, can so modify its actions, as to give the same result. If it be true, that sensation is modified by structure, then it will follow that each structure should have a sensation of its own, and that instead of five senses, we may have twenty or fifty.* As the brain, (by which term I mean to

* Every structure or tissue in the body has, it is believed, a sensation peculiar to itself, which especially relates to its function, and conservation. An ache, is the sensation peculiar to bone, and is produced by pressure. The bones are the levers of the organs to which the mechanical powers of the system are applied. Now pressure is the appropriate cause by which a lever or any other mechanical instrument effected is ordinarily put in motion: hence it was necessary that the bones should have a sensibility and sensation, derived no doubt from their peculiarity of structure, which should at all times inform us of the fact, that they were subjected to an undue degree of that kind of force either from its internal or external application; internal when it arises from a morbid state of distention of the vessels of the bone, as when inflammation is going on in its structure; or external, as any one at any time may satisfy himself by making pressure with the thumb upon the shin bone, or indeed any other bone in the body which is thinly covered. This ache is the sensation which, when experienced in a degree that compromises the safety of the part, prompts us to seek relief; hence its conservative utility. Fatigue is the sensation peculiar to the muscles, the organs of motion; and is produced by an excessive exertion of their powers. Its final end is to admonish us of the necessity of suspending further effort. If we do not heed the timely admonition, the function, and perhaps indirectly the structure of these organs will be seriously deranged, injured, or even destroyed. So of all the other distinctive tissues of the body. It might be amusing and instructive to all, but it is emphatically interesting and important to the physician, to understand this subject; for it enables him to ascertain with considerable accuracy the seat of disease, by attending to and analyzing the pains and feelings complained of by patients.

include the encephalon and spinal marrow and their appendages, the nerves) is composed of a great variety of different parts, each of which is, I suppose, capable of modifying in its own particular way, perception and reflection, the functions of the mind, it would seem to flow from our doctrine as a corollary independent of the arguments of the phrenologists, that the brain is made up of a congeries of organs, every one of which has a mode of perception and reflection peculiar to itself.

We shall proceed to show, that besides this modification of the properties and functions of vitality by structure, sensation and motion the two essential functions of life are also modified by physical causes, which may be divided into two species, viz: chemical and mechanical. It is absolutely necessary that these functions should be thus modified, otherwise the same physical cause would not produce the same change: consequently, the same sensation or perception could not be expected invariably to follow. It is owing to this power of physical causes to modify sensation and perception, that aloes is always bitter; honey always sweet; vinegar always sour; &c., &c. The same may be said of physical causes addressed to the other senses, as smelling, tasting, feeling, &c. Now, why is it so? The reason is, that it is an universal and immutable law of nature, that the physical properties essential to each particular kind of matter should always be the same. The same law holds good in regard to changes produced in the mind as well as in the body: and hence it is that objects of the same physical properties, if they produce any change in the mind, always excite the same ideas, the same trains of thought, the same intellectual operations, and indeed, the same emotions: therefore, a transparent body always excites in the mind the idea of transparency, and a disagreeable object always the emotion of disgust, because they always produce the same changes of action in the brain, the organ of mind. To this it may be objected that the same impressions, whether physical or mental, after a time, cease to produce the same changes, and consequently

cease to excite the same sensations and perceptions. This, however, is owing to another law of the system, viz: that frequent repetition or constant application of the same causes destroys the susceptibility of the part to which they are applied, to their particular impression; as the irritation excited in the skin of a person not accustomed to wearing flannel soon ceases to be perceived. It is owing to the same law that the same dose of medicine repeated daily, soon ceases to produce its appropriate effect, that the same quantity of alcohol ceases to intoxicate. This law is universal, and therefore, its influence extends to the mind. For instance, the same object of distress presented daily, would soon cease to excite emotions of pity or compassion. The wisdom and goodness of God are very clearly manifested by the institution of this law of the system; for by the frequent or constant application of hurtful agents to our bodies, they lose their susceptibility to those impressions: and hence it is, that persons who have become acclimated, will be exempt from diseases of a particular region, while strangers moving into it are soon affected.* In like manner the mind ceases to be annoyed by the frequent repetition or constant application of moral causes which are calculated to disturb its equanimity, because that part of the brain, the organ of mind, upon which those causes have so constantly or repeatedly acted, has lost its susceptibility to their particular impression. Again, to carry the analogy a little farther, frequent change of action or derangement of function in an organ, is sooner or later followed by a change of structure in that part, and we have permanent disease, or what medical men term organic disease, which, if in an organ whose function, as that of the heart and lungs, is essential to life, is generally considered

* It is owing to the prevalence of this law, that the tobacco chewer and the rum drinker are not speedily cut off by the use of those poisons, and it is owing to the same cause, that a person by taking daily a quantity of arsenic, would come at length to take with impunity a dose which would destroy the life of another who had not been habituated to its use. In this way, murder is said to have been committed without suspicion.

incurable, because the change of function caused by this very change of structure tends to give permanency to the morbid state of its organization. So in regard to the mind, which is the function of the brain, when any moral cause is frequently repeated or constantly applied, the very structure of the brain becomes altered, and we have incurable madness or mania.

Another law by which changes of action or function in the body are modified is this; that when any part has been deprived of its susceptibility to a particular stimulus or impression, it may be specially restored by merely changing the physical cause; and it is on this principle that many diseases which are only functional are cured. So in the mind, when it has lost its susceptibility to any moral cause, for the same reason it may be restored by simply exchanging that for another; and hence it is, that many are so much relieved, or even cured of insanity by a mere exchange of the moral causes which have deranged the intellect, for those which tend to restore its susceptibility, or for such as are suited to renew its healthy operations: and in this consists the grand secret of curing that most terrible of all maladies. Again, the functions of the body are modified by the quantity of arterial blood circulating in the particular part to which the altered function belongs. And here the analogy is drawn still closer; for the operations of the mind, like the functions of every other part of the body, are altered or modified by the quantity of blood which for the time being, is circulating in the brain, the organ of the mind. If the physician wishes to increase the function of an organ he has only to contrive to throw a little more blood into it. If it be an organ of secretion, as the liver or lachrymal gland, an increased quantity of bile, or of tears will be the result. If it be an organ of motion, increased mobility will follow. If it be the mental organ, an increased quantity of thought will be produced. Do you ask for proof. Take a glass or two of wine, a cup of tea or coffee, or a pill of opium, which induce the vessels of the brain to relax, and conse-

quently admit more arterial blood into that organ, and you will have an increased quantity of function; the intellectual wheels will move on with more power, as well as rapidity; or if any one, in these days of te-totalism, should object to these expedients, for increasing the powers of the mind, or more properly speaking, the function of the brain, he may be told that its functions, like those of every other organ under the control of the will, may be increased within certain limits by exercise. To illustrate as well as to carry on the argument. The muscles are the organs of motion, and when we begin to put them in action, as in the morning on rising from the bed, or when we engage in any exercise requiring more than ordinary exertion, we find our first movements are comparatively feeble and inert; but as we go on exercising, they become more and more facile and agile, increasing in celerity and power; and why? because more blood is brought by exercise into the muscles. So when we begin to think on any subject, especially if it be one upon which we are not accustomed to meditate, the first operations of our minds are feeble, but by a continuance of the effort they become stronger and stronger, because by exercise, more blood is derived to the brain. All of us have, undoubtedly, noticed the paleness of an orator's face when he begins to address an audience, and have observed that his first efforts are feeble and labored: but as he goes on, color comes in his face, his eye kindles, and his whole countenance glows; phenomena which indicate that more blood has by some means or other gained admission into the vessels of the head, and consequently into those of the brain; his thoughts now come with rapidity, his intellectual operations proceed with power, his ideas follow each other in such rapid succession, that he cannot stop for words and expressions to represent them, his mouth is a door of utterance, out of which language flows with the same facility and rapidity with which thoughts pass through his mind. If now the effort be much longer continued, the vessels of the head will become so distended with blood,

that they are compelled to resist, and often painfully, and it is in this way we explain the fact that many persons experience headache after intense thinking, or a vigorous effort at public speaking, just as pain is produced in the muscles, the organs of motion, by long continued or severe exertion.

We shall push this part of the inquiry no farther at this time, but proceed to show how the functions of the living body are commenced and carried on; how physical causes produce action and changes of action in the system; and endeavor to prove that their mode of producing action and changes of action in the mind, is exactly similar to that by which they produce action and changes of action in the body, and also that moral causes operate on the body exactly like physical causes, and that in the production and change of action, they are governed by precisely the same laws, and consequently, that to educate the mind, it is absolutely necessary to educate the body. The function of every organ in the body is performed by a set of vessels called capillaries, from the fact of their being exceedingly fine, like the smallest hairs. They are to be considered as the principal antagonists of the heart, or as furnishing in every part of the body antagonistical resistance to the action of that organ. Their action is modified in each particular organ by the substance which has been thrown around and among them, by which they are connected together; a circumstance which gives peculiarity to their function, as well as identity to the organ. These working vessels, which do the business of the system, are in the first instance excited to action by physical causes, chemical or mechanical; and we will here premise that the impressions which they make are either agreeable or disagreeable, painful or pleasureable as the case may be, because upon this important fact is based a law by which their influence is greatly modified. We shall assume, as it will fully answer our purpose, that life commences at birth, and that the body is then completely formed and furnished

with all its appropriate fluids. The air, as in the case of the first man, while in the very hands of his Creator, rushing into the nostrils of the new-born infant, reaches and expands its lungs; by which expansion all the pulmonary vessels are enlarged and elongated. Prior to the expansion of the lungs, their vessels, except such as were necessary to nutrition are supposed to be empty. According to a well known law of hydraulics, into these vessels, in which a sort of vacuum had been thus formed by the expansion before alluded to, the fluids would flow and distend them, until by simple mechanical distention, they would be excited to resistance, and stimulated to contract; which would force a portion of their contents out of them into other vessels. The mere weight of the atmosphere, which is about fifteen pounds to the square inch, would of itself put the delicate air-vessels of the lungs on the stretch, and stimulate them to contract strongly; which, by forcing out a quantity of air, constitutes expiration. When this was accomplished, according to the law of the system, which is that every degree of contraction should be followed by a spontaneous relaxation, generally in proportion to the previous contraction, these vessels would relax, and again of course, be filled and distended, by the in-rushing of another portion of atmospheric air, which constitutes inspiration. What an organ as a whole does, will be done by all its vessels; therefore, the contraction of the lungs in expiration, forces the blood out of their vessels into the heart, (a hollow muscle) and distends it; as mechanical distention is the natural or physical stimulus which excites the muscles to act, it causes that organ to contract, and the blood is thrown into the arteries, and through them, into all parts of the system, where it stimulates every vessel and every part to act; for every organ will do what all its vessels do. Hence it is, that when the vessels of a muscle are distended with red or arterial blood, they will be prompted to contract in order to force it out, and what all the vessels of a muscle do, the same will the muscle as a whole do;

that is, it will contract as a whole, and its legitimate effect as an organ of motion will be manifested. Now the nerves, which give the vessels the power to feel the impression of the fluids, and also enable them to act, or rather re-act upon their contents, take cognizance of their action or contraction, and so to speak, communicate the intelligence to the sensorium; or to use another mode of expression, they produce a change of action in that part of the brain in which they (the nerves) originate, and there excite the perception of this change, which constitutes thought. This change, and the consequent perception of it, is repeated again and again, as often as the original cause is applied, until at length the brain or some portion of its vessels, gets a habit of acting in this particular way, and then the individual, by fixing his attention upon this perception, may excite at his pleasure the same change of action in his brain, and thus reproduce the same perception, idea, or train of thoughts. Having learned from experience that he has acquired this power over the vessels of the brain, he comes at length to desire to have it, (the change) reproduced in the absence of its physical cause: and by trying again and again, he acquires the power of reproducing it, and then he will have the idea of that which was the physical cause of the change, as well in its absence as in its presence. This constitutes voluntary thinking; the only mode of thinking which strengthens the mind, or produces any valuable results; the art of which it is the object and business of education to teach.*

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* When a physical or sensible object is presented to any of the senses, to the eye for instance, the light reflected from it enters the organ, and produces a change in the state of the retina, which is transmitted to that part of the brain from which the optic nerve arises, and there produces a change which is perceived; imperfectly at first, it is admitted, especially in early infancy: but when the same sensible object is presented again and again, the change each time will be produced, perceived and compared with previous changes until the consciousness of its having been perceived before, is fully awakened; when, almost simultaneously with consciousness another faculty to wit, attention is originated. Now attention is voluntary or involuntary. At first it is involuntary, but by

It remains to be shown, that the muscles called voluntary, become subject to volition or the will, in the same way as the power of the will over the action of the vessels of the brain is acquired, which has just been considered and attempted to be explained. The blood flowing into the muscles as soon as their vessels are large enough to admit it, excites them to act, and they do act involuntarily at first, before and for a considerable time after birth. In this way, muscles are first prompted and excited to act. The nerves, besides supplying them with the power to feel and to move, take cognizance of the motion thus excited, and transmit a knowledge of it to that part of the brain, or spinal marrow in which they have their origin, and there produce a change in the actions of its capillary vessels which, in a longer or shorter time after birth, (perhaps before as some think,) and after frequent repetitions comes to be perceived; and when it has been perceived again and again, the individual taking pleasure in the perception and consciousness of the change excited by the transmitted action of the muscle, desires, and at length determines to reproduce it, and by frequently

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repetition, emotion is produced, which is soon followed by desire, or its opposite aversion. Consciousness and attention, constitute the understanding; desire and the determination to which it gives rise, constitute the will. Consciousness and attention are attended with pleasure; the pleasure of knowing, or of knowledge, which at first is passive, but which by repetition becomes active, and then follows the desire of reproducing thought, and soon that of acquiring new ideas. Thus, when an idea has been produced again and again by the presence of a physical object, we come at length to desire its recurrence in the absence of its archetype, the physical object, and by single or repeated trials, the individual acquires the power of producing the same change in the vessels of the brain, which was excited by the physical agent when present, and then will the identical idea or ideas be produced, and the same consciousness and attention will ensue; the identity of which is settled by comparison with previous results. At first the reproduction, it is true, will be more or less difficult, and more or less perfect, until bye-and-bye, the individual acquires a perfect control over the action of the vessels concerned in the process, and then the result is obtained with the greatest facility. It is in this way, that we acquire the power and the habit of voluntary thinking, as any one may convince himself who will take the trouble of patiently watching the operations of his own mind, especially when endeavoring to master a new or difficult subject.

repeating the effort, acquires the power to reproduce it, (i. e. the change in the brain, or spinal marrow,) and then the muscle moves in obedience to his will, and then, and not till then, does it become a voluntary muscle. Let any one observe how the child learns to walk; or how he himself must proceed when he would perform any motions which are entirely new to him. In the performance of such, do his muscles at first move with precision in obedience to his will? Or has he to train and educate them just in the same way as he did when a child? It is in this manner that all our voluntary powers, whether of mind or muscle, of thought or action, are acquired, and in fact strengthened. By thus acquiring the power of changing the actions of the vessels of the brain, and making them subservient to our will, we can learn to think on anything we please, or continue a train of voluntary thinking on any particular subject. When these vessels have been obliged by the will to act for a considerable time in any particular manner, they become fatigued like the vessels in the voluntary muscles, and sooner or later, we are tired of thinking on this or that particular subject, and if we do not now stop or turn the current of thought into another channel, or to another subject, the effort will become painful. So in the muscles, when we have fatigue from any particular kind of action, we must either stop, or change it for some other effort in order to be relieved from that sensation. Voluntary thinking, like voluntary action, causes fatigue, and these are the only modes of action that do cause it. From the view of the subject just taken, and the reasoning thereon, we learn that God has not endowed man with voluntary powers, and consequently, has not made him a moral agent; but it is true, that he has so constructed and constituted him, that he becomes such by his own choice and efforts, (in the manner already shown,) and therefore it is right and proper, that he should be held responsible for all his voluntary acts. But the question, how do physical causes operate on the capillaries of an organ to make them

act at all, or to change their action still remains to be answered. We have said, that the impressions which they make are agreeable or disagreeable, pleasurable or painful, and that upon this fact, was founded an important law, by which actions of the body were regulated. The law is this; anything that makes a pleasing impression on the body, induces the vessels of the part, on which it is made, to relax, and whatever makes a disagreeable or painful impression on it, induces its vessels to contract, or in other words, to resist.* The latter part of this law is, however, modified by another circumstance, which is this: if the impression be made on the outside of the vessel, or exterior to an organ, and be stronger than that made on the inside by the fluids within, it will produce relaxation, upon the principle pointed out by Hypocrates, that the stronger effaces the weaker impression. If the impression, exterior to an organ, be stronger than that within, its vessels will relax, and continue to do so, until they become distended and over distended, and come at last to resist painfully, and then we are assured that the internal is stronger than the external impression. We do not, however, resist corporeally or mentally, whatever is pleasing to us; and therefore, it is, that the first part of the law which causes the vessels to relax in consequence of pleasurable impressions, holds equally whether they be made internally or externally. Notwithstanding, if it be external, it operates on the same principle, as if it had been disagreeable or painful, because if the external pleasurable impression be stronger than that which is made by the fluids within the vessels, they will relax or forego their resistance, and allow themselves to be distended. We wish to have it kept in view, that in this way we explain the influence of causes which produce changes in the mind, by operating upon the vessels of the brain, the organ of the mind. There

* So far as the author recollects, this important doctrine was first broached and promulgated by the celebrated English orator, Edmund Burke, in his work on the Sublime and Beautiful.

is in this respect, no difference between the formation of ideas by the brain, and the secretion or formation of bile by the liver. The general principle is the same. Both are the functions of their respective organs, but with this difference, that the peculiar organization of the brain, constrains it not only to form ideas, but, so to speak, to know what it is doing, or to be conscious what ideas it is forming, what trains of thought it is carrying on, and to what conclusions it has arrived; while the liver, from its own peculiarity of structure, is compelled to make bile if it do anything at all; but is not allowed to know what it is about; and therefore, it can never be educated; but the brain is the organ toward which all our efforts at training should be directed, and hence, the importance of being well acquainted with the mode in which changes of action in it, are effected, and the laws by which they are regulated and governed.

If we would get a new idea, we must try to make the vessels of the brain undertake the precise action necessary to its production or formation, just as we would try to make certain muscles perform a certain action entirely new; and we all know that this is done by repeated efforts; and exactly in the same way the formation of a new idea is to be accomplished. *If we would get an idea into the head of another, we must try to make the vessels of his brain act just as the vessels of our brains acted or do act when that idea was or is present in our minds.* And as we can perform any set or series of motions with a facility proportioned to the frequency with which we have performed them, so we can carry on with ease any trains of thought in proportion to the number of times we have obliged them to pass through the mind, and thus we get habits of thinking just as we do habits of acting.

THE PASSIONS.

We shall now proceed to consider a class of feelings or emotions which have been considered as exclusively mental, and therefore more particularly appropriate to the design

we have in view. These mental feelings are excited by external causes, and are involuntary. They are termed passions, and have been generally, but I think very erroneously, considered distinct from intellectual operations. The reasons for this opinion are not strictly called for, and therefore will not be assigned. The ordinary movements of the vessels of the brain are, like those of every other organ, owing to the influence of impressions unconsciously made on their internal surfaces, constantly and uniformly prompting them to act, and consequently during our waking hours to keep up a train of thought, which is continually passing through the mind, without our knowing why or wherefore, as in the case of some people who are said to whistle for want of thought.

This kind of thinking arises from the automatic movements of the vessels of the brain, and has little more effect in augmenting the knowledge of the individual who practices or indulges in it, than the automatic movements of the vessels of the liver, or the lungs. It is voluntary thinking only, which, like voluntary action, produces important results. This regularity of action in the vessels of the brain is, however, liable to be disturbed by impressions from without, more powerful than those made by the fluids within the vessels, and change of action in the vessels of the organ of mind will produce change of feeling in the mind itself, and this change of feeling may react and produce changes of action in the brain, which, with their results, (i. e. actions in other parts,) constitute the influences of the passions on the body, and are not unfrequently the cause of serious disease; but they act in the production of disease, and in all other respects on the same principle as physical causes. The passions, like physical causes, may be divided into two classes, painful or pleasurable, according to the kind of feeling which they produce, or with which they are accompanied or attended. The passions belonging to the first class, are grief, fear, and anger. Those belonging to the second, are joy, hope, and love; all the other passions may be considered as mere

mixtures or modifications of these six. Perhaps we might simplify them still more, and say that there were two only, grief and joy.

GRIEF.

Loss or damage is the physical cause which disturbs the circulation of the brain, and gives rise to that painful emotion of the mind, which is termed grief. Why does this sense of privation alter the circulation of that organ, and in what does this alteration consist? It consists in an increased quantity of blood in the brain, or in some portion of it; the phrenologist would say, in the organ of acquisitiveness. That there is an increased determination of blood to the head, is obvious from the redness of the face and eyes, and from the sense of fullness in the head, so often noticed and complained of by persons affected with grief, and in some instances, apoplexy is produced by this passion. How does grief operate in the production of this increased fullness of the vessels of the brain? One of two things must take place, either the action of the heart must be increased, or the vessels of the brain must relax; and it is obvious from all the phenomena of grief, that the former does not occur, for, the pulse of a person laboring under the influence of this passion is slow, the heart not unfrequently seems to pause in its action, and every sixth or eighth beat is lost, and the afflicted person is insensible to everything about him, and even neglects the calls of nature; food and drink are either refused or not thought of, and the voice of friendship and sympathy falls unheeded upon his ear. Nothing interests him. As the increased action of the heart can not be called in to explain the increased fullness of the vessels of the brain, we must turn to the other cause, viz: a relaxation of the vessels of that organ; and the question, how is this relaxation produced, again recurs. We have said, that an impression made exterior to an organ which is stronger than that made by the fluids on the vessels of the part, will cause those vessels to relax, and be-

come distended, and perhaps overdistended, upon the principle laid down by Hypocrates, that the stronger effaces the weaker impression. Now, the cause of this passion is the loss, or privation of an object that is exterior to us; is disagreeable or painful, and is stronger than that made by the fluids within the vessels of the brain: and hence, those vessels relax or forego their resistance, and suffer themselves to be distended; and if the cause of grief be very great or sudden, death may be the consequence, as happened in the case of Eli, the judge of Israel, who, when he heard of the death of his two sons, Hophni and Phineas, and of the capture of the Ark of the Lord, fell down and died. With such results, most of us are familiar, either from report or our own observation. It is like a blow on the head, which stupifies or causes death, by causing the rupture of a vessel of the brain, or by inducing inflammation of that organ. An increased determination of blood to an organ, we have said, increases its function, if it be within certain limits, but if it be excessive, so as to overdistend its vessels, and cause them to resist inordinately, then it interrupts or destroys the function of the organ in question, and this is precisely the case in sudden or violent grief. The vessels, taken by surprise, forego their resistance, and become so overdistended, that they cannot perform their regular and appropriate function, which, in the brain, cannot be long suspended without fatal consequences. Hence, it is proper when we have intelligence to communicate, which is calculated to produce sudden and violent grief, to prepare the mind of the person to whom the communication is to be made by such information as will gradually lead him to infer the result. Nature's method of preventing the disastrous consequences of grief, by unloading the distended vessels of the head, is in perfect keeping with the regularity and uniformity of all her laws, and is moreover, a striking illustration of the one alluded to; that the function of an organ is increased by increasing the quantity of arterial blood in its vessels. In grief we have said, that there is an increased

determination of blood to the head: in which case, the face, eyes, and lachrymal glands, all participate, and if the rush be not too violent, an increased quantity of tears is secreted. Hence it is, that weeping always brings relief, and in part, secures the patient from all danger by unloading the vessels of the brain of so much of their contents, as will secure the integrity of the organ, and consequently, the continuance of its function. Weeping is, therefore, to be always greeted as the bow of safety, indicating that the storm of grief which threatened destruction, is passing away. In very sudden and very violent grief, we must "weep or die."

FEAR.

The next of the painful passions is fear, which operates upon another and opposite principle. Instead of producing a relaxation of the vessels of the brain, it causes an increased contraction, not only in the vessels of that organ, but in those of other organs under its control or influence. Hence, color flies from the face of him that is affrighted, and a universal tremor, arising from the violent contractions of the muscles of voluntary motion, seizes him; and furthermore, when the emotion is extreme, this universal contraction fixes the victim immoveably to the spot on which he stands, as well as deprives him of his senses. The ancient poets understood this. Homer, speaking of Dolon, who was surprised while on his way to the Grecian camp by Ulysses and Diomede, says:

> ——— "Against the trembling wood,
> The wretch *stood* prop'd, and quivered as he *stood*,
> A sudden palsy seized his turning head,
> His loose teeth chattered, and his color fled."

This passion is caused by any object which excites in us the apprehension of personal danger. Its impression is painful, and it refers alone to ourselves, and by turning our thoughts inward, and fixing them upon ourselves, it has

precisely the effect of a disagreeable impression made on the inside of vessels, and should therefore, upon the principle which has been laid down, produce contraction, and it is on this principle that we explain its phenomena.* We have said, that fear contracts the muscles, and fixes its subject like Dolon, to the spot on which he stands. Now, to this, it might be objected, that the affrighted are apt to run away, and sometimes actually do: poetically speaking, "fear adds wings to their flight." This, however, is a mistake. Fear prompts no one to fly, but rather deprives him of the power of flight.† The reason why an affrighted person runs away

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* This passion may act medicinally in cases in which the vessels are overdistended, as in inflammation, &c., and there are not wanting in the records of the profession examples of its efficacy, as a remedial agent. A gentleman afflicted with gout, often cursed his foot and wished it at the devil. In one of these paroxysms of rage, a terrible agitation and commotion occurred in the chimney which began at the top and descended with frightful rapidity to the fire-place in the gentleman's room, which was instantly filled with soot and dust, in the midst of which up rose an imp of diminutive size, who made the astounding announcement that his master was coming and would soon be there. The gentleman mistaking him for a little devil, (who was in fact only a chimney sweep's boy, that had been sent to explore the chimney and give information of the speedy advent of his master, but who making a false step in the discharge of his mission, had fallen from the top to the bottom of the flue,) and concluding that the old devil himself had taken him at his word, rose and fled. The gout, we are informed, left the gentleman quite as unceremoniously as he had left the room.

† "George Grochanzy, a Polander, who had enlisted as a soldier in the service of the King of Prussia, deserted. A small party was sent in pursuit of him, and when he least expected it, they surprised him singing and dancing among a company of peasants, who were together in an inn, and were making merry. This event, so sudden and unforeseen, and at the same time so dreadful in its consequences, struck him in such a manner, that giving a great cry, he became altogether stupid and insensible, and was seized without the least resistance. They carried him to Glaucau, where he was brought before a council of war and received sentence as a deserter. He suffered himself to be led and disposed of at the will of those about him, without uttering a word, or giving the least sign that he knew what had happened, or would happen to him. During all the time that he was in custody, he neither eat, nor drank, nor slept, nor had any evacuation. Some of his comrades were sent to see him; after that he was visited by some officers of his corps, then by some priests; but still continued in the same state, without discovering the least signs of sensibility. Promises, entrea-

from the cause of danger, is not owing to fear, which, as we have shown, would rivet him to the spot; but to hope, which naturally prompts to action.* This it will be seen is in perfect accordance with one of the physiological principles which have been laid down, viz: that violent contraction will be followed by a spontaneous relaxation which is generally in

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ties and threatenings were equally ineffectual. The physicians who were consulted upon his case, were of opinion that he was in a state of hopeless idiocy. It was first suspected that these appearances were feigned; but these suspicions necessarily gave way, when it was known that he took no sustenance, and that the involuntary functions of nature were in a great measure suspended. After some time, they knocked off his fetters and left him at liberty to go whither he would. He received his liberty with the same insensibility that he had showed upon other occasions. He remained fixed and immovable. His eyes turned wildly here and there, without taking cognizance of any object, and the muscles of his face were fallen and fixed like those of a dead body. Being left to himself, he passed twenty days in this condition, without eating, drinking or having any evacuation, and died on the 20th day. He had been sometimes heard to fetch deep sighs; and once he rushed with great violence on a soldier, who had a mug of liquor in his hand and forced it from him, and having drank off the liquor with great eagerness, let the mug drop to the ground." The foregoing furnishes one of the most remarkable cases of genuine fear and its consequences on record. In this case of the Polander, no relaxation followed the previous contraction of the capillaries, consequently no hope sprang up in his bosom.

* The following case in exemplification of the doctrine of the text may be somewhat amusing:

"Charles Gustavus, King of Sweeden, was besieging Prague, when a boor of most extraordinary visage, desired admittance to his tent, and being allowed entrance, offered by way of amusement to the King to devour a whole hog of one hundred weight in his presence. The old General Koningsmarc, who stood by the King's side, and who, soldier as he was, had not got rid of the prejudices of his childhood, hinted to his royal master that the peasant ought to be burnt as a sorcerer. "Sire," said the fellow, irritated at the remark, "if your majesty will but make that old gentleman take off his sword and spurs, I will eat him immediately, before I begin the hog." General Koningsmarc (who at the head of a body of Swedes, had just performed wonders against the Austrians, and who was looked upon as one of the bravest men of the age,) could not stand this proposal, especially as it was accompanied by a most hideous expansion of the frightful peasant's jaws. Without uttering a word, the veteran general turned suddenly round, ran out of the room, and thought himself not safe until he had arrived at his quarters, where he remained twenty-four hours, locked up securely, before he had got rid of the panic which had so completely affected him."

proportion to the previous contraction. Now when the vessels, which contracted under the influence of fear, begin to relax, hope springs up in the mind of the sufferer, and his efforts to escape will be in proportion to his previous apprehension of danger. Without this spontaneous relaxation of vessels, no ray of hope could come: unyielding and unutterable despair would have entire possession: the functions of life would cease, and the person would die: he would be literally "scared to death." To carry out the analogy: it is not necessary that the physical cause of fear should be present, or actually exist. The emotion, as in the instances already adduced, of sensations produced in the absence of their appropriate physical causes, by the mere action of the vessels of the part experiencing them, may be produced by the simple apprehension of danger, when there is no real cause for it, as is the case with persons who "borrow trouble," or are frightened at "chimeras dire," ghosts and hobgoblins. A ludicrous exemplification of this truth, many will recollect, is given in the narrative of the life and adventures of Don Quixotte.

JOY.

This passion is the converse of grief in every respect, whether physically or morally considered. Joy is a pleasurable; grief, a painful emotion. Joy brightens the eye, prompts to activity, and renders mind and body more intensely alive to every impression, and causes every function of both to be performed with alacrity and delight: Grief bedims the eye, diffuses a torpor and listlessness over body and mind, rendering both indifferent to external impressions and passing events, indisposing to motion and causing every function, corporeal and mental, to languish.

We have stated that mental impressions operate on the brain just as physical impressions do on the organs of sense; the pleasurable, producing relaxation, and those that are painful, contraction of the vessels of the part subject to their influence; and it is a fact that other organs are brought

by sympathy into the same condition. In grief, the cause being painful and external, the attention is abstracted from everything within and personal, and is fixed upon that cause: hence the vessels of the brain forego their resistance, yield, are overdistended, and, as has been laid down as an axiom in physiology, that the function of an organ is invariably disturbed, suspended or destroyed when its vessels are preternaturally and inordinately distended, so we find the function of the brain is suspended from that cause, and therefore it does not transmit the requisite and wonted degree of nervous power to the other organs of the body, and on this account their vessels do not feel the impulse of the fluids within, and of course do not resist, but suffer themselves to be too much distended for the due performance of their appropriate functions; in grief, the vessels of the heart, the lungs, the stomach, the muscles, the organs of locomotion and also those of the organs of secretion, sympathising with those of the brain, become overdistended: hence, the slow, sluggish or intermitting pulse; the interrupted breathing, with frequent sighing; the loss of appetite and digestion; the indisposedness to action, as well as the suspension of the ordinary secretions. In joy, the very reverse of this takes place. Under the influence of this passion the vessels of the heart, the lungs and the muscles, sympathizing with those of the brain, relax; hence, the bounding pulse, the heaving bosom, the nimble foot, and the "leaping for joy."

Joy, like grief or fear, when excessive, may produce the most deleterious effects, as in the case of Diagoras, who died from excess of joy, on the crowning of his three sons as victors at the Olympic games. Joy, when inordinate, is in fact, more dangerous than any of the depressing passions, on account of the increased energy with which the heart acts; which, by forcing an undue quantity of blood into the relaxed and yielding vessels of the brain, causes them to be so distended or overdistended, as to produce inflammation in its substance or membranes, or a suspension, temporary or permanent, of its functions.

ANGER.

Anger, of all the passions, is the most displeasing. Its cause is external, and always painful; and, therefore, induces relaxation of the vessels of the brain, and consequently, the admission of a greater quantity of arterial blood into that organ, which, as has been said, always increases the function of an organ, provided it be moderate, but if immoderate or inordinate, it will suspend or annihilate its function. In anger, the vessels of the brain relax, and receive more red blood:* hence, the powers of the mind are increased. The vessels of the heart and of the muscles, the organs of locomotion, sympathizing with those of the brain, also relax, and more red blood is admitted into them; hence, the increase of their activity, besides an increased amount of nervous energy, (the production of which, like that of thought, is also a function of the brain,) is transmitted through the nerves to the heart, and other muscles. Under the influence of this passion, if moderate, all the powers and faculties of the mind and body are augmented; if immoderate, they may be, and sometimes are, suspended or destroyed. John Hunter, one of the brightest ornaments of the medical profession, is said to have died almost instantaneously, from a sudden gust of anger.†

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* Red blood is that which circulates in the arteries; black blood that which circulates in the veins. Red and arterial, applied to blood, are synonymous, as are also black and venous.

† Although this passion may be productive of fatal effects, yet it may be, and often is employed either by accident or design, as a powerful remedial agent, of which I have known many instances. A woman in New Hampshire, who was exceedingly troubled for breath, said to her husband, in her anguish, "Oh! I must die; I can not breathe any longer!" "Never mind, my dear," was his consoling reply, "you need not breathe; nobody wants you to breathe any longer!" It is hardly necessary to add that the lady made a most rapid recovery, and lived many years to be the companion of her tender spouse.

HOPE.

Hope is a pleasing passion, and, as we have seen, very generally springs as a matter of necessity from the cessation of fear, and perhaps it always arises in this way, for we first think of what may be beneficial to us; then we desire to possess it; then we set about the method of acquiring it, whereupon, the obstacles to its attainment presenting themselves, and being disagreeable, produce contraction of the vessels of some portion of the brain, and fear is the result. If this contraction be followed by a spontaneous relaxation, or obviated by a discovery, that the obstacles may be removed or surmounted, hope springs up, and all our energies are exerted to procure the desired object. Hope increases all the powers and faculties of the mind as well as the functions of the body, and is never dangerous, either in its direct or indirect consequences; it is, therefore, as "an anchor to the soul, sure and steadfast."

LOVE.

Love is a pleasurable passion, and will consequently produce a relaxation of the vessels of the brain, whether it is excited by an internal cause, as an overweening self-conceit, or by an external object. It is, however, very apt to have some other passion associated with, or engrafted upon it, which greatly modifies its effects on the mind, and also on the system generally. When obstacles present themselves, which appear to be too formidable to be overcome or removed, the apprehension of losing the object beloved, excites fear, and we have the sighing, despondng lover. If a rival presents himself, anger is roused, and we have jealousy; if hope, then we have the ecstasy, the very poetry of love. All the other passions seem to be mere modifications of the foregoing, and their influences on the mind or body might be easily described, by successively analyzing them, together with their complications.

GOVERNMENT OF THE PASSIONS.

In all educational movements, the passions present some very important considerations, which divide themselves into two classes. 1st. Those which regard the government and control of the passions themselves; and 2ndly, those which regard the use which is to be made of them in strengthening the mind, and rendering its operations more vigorous and efficient in the attainment and application of knowledge.

First: the control and government of the passions. It is admitted by all, that the passions are involuntary; how then shall they be controlled or governed? How shall a man become the master of his own spirit! The rule is very short, comprehensive and infallible. If the passions be involuntary, their external signs notwithstanding, are ever subject to the will. Let these be withheld, and the emotion either ceases, or readily submits to the regulations of reason: or what is still more efficacious, let the individual under the influence of any passion determine to manifest the external signs of its opposite, or antagonistic emotion.* For instance, let him that is angry, expand his brows, and compel his features to assume the external signs of pleasure, or of laughter, and the tiger instantly retires to his kennel, and the probability is that the subject of the experiment will soon find himself in the laughing mood,—at least the propensity to strike will have ceased. To reverse the position, let him that is pleased, or disposed to laugh, knit his brows, and assume the expression, attitude and gestures of wrath, and the propensity to smile will soon subside. If ever so well pleased, let "the monarch frown, and from his eyeballs flash the living fire:"—soon he will be in no very "melting mood." The pupil must be instructed when he feels the first kindlings of anger, to expand the brows, be silent

* A friend has referred me to Seneca's morals for some facts, in relation to this subject; but I have not been able to lay my hand on that book, and as it is some fifty years since I read it, I cannot say whether the above suggestions have been derived from it or not

or use soft words and gentle motions, and he will easily quell or control the rising storm, as reason shall deem best. When it is desirable to control or regulate any other passion, the same rule should be followed.

The second consideration. What uses shall be made of the passions in strengthening the mind and rendering its operations more vigorous and efficient in the attainment and use of knowledge? The axiom in physiology, that an increased determination of blood to an organ, if moderate or within certain limits, increases its function, will greatly assist us in arriving at just conclusions upon this part of our subject. Now the production of thought and nervous energy is the function of the brain, how then is its function to be increased? The answer is, by rendering its circulation of blood more active. What passions then shall be called in to aid us in the production of this effect? Not grief, certainly, for although it causes a relaxation of the vessels of the brain, and consequently an increased determination of blood to that organ; yet by fixing the attention exclusively upon the object of bereavement, it causes the sufferer to disregard all other matters, and therefore produces torpor and inactivity of body and mind, causing the functions of both to languish, it is therefore unfavorable to the improvement of either. Neither shall we invoke the passion of fear, for that, as we have seen, produces contraction not only of the vessels of the brain, but of all other organs under its immediate control, and thereby paralyzing every effort.

Than fear, no other passion, if we except grief, is so hostile to mental improvement. Here the subject of corporeal punishment as a mean promotive of educational purposes, is forced upon our consideration. It has been, and is perhaps even now, a pretty generally received opinion that the rod or the ferrule is an important if not an essential agent in the education of youth; it has, however, been, particularly of late, objected to by many as debasing the mind by bringing it under the influence of a slavish fear,

and in this point of view it is, we conceive, altogether objectionable upon the principles laid down in this treatise. That the rod in the hand of a judicious teacher has sometimes answered a valuable purpose, we are ready to admit; but the true principle of its agency has we believe been entirely overlooked—that it has often stimulated many an idle boy to get his lesson, who would have utterly neglected it, is not to be denied, but upon our principles it is not the fear or dread of the instrument, but the hope of escaping its torture, which has prompted the idler to exertion and study. Fear stupifies and paralyzes: Hope exhilerates and excites to action.

All infliction of corporeal punishment, except for faults of a criminal nature, such as lying, &c, should be banished from our schools; because it is in the power of every teacher who is duly qualified to excite hopes of a higher and nobler description, than that which only looks to an immunity from bodily pain.* Notwithstanding, we believe that it consists with the duty of the instructor very often to place before the mind of the pupil, the inconveniences and disadvantages which inevitably result from ignorance, as well as the benefits which spring from knowledge, for the purpose of arousing in him the hope of avoiding the former, or of obtaining the latter by a diligent application to study. Anger, as it has been shown, increases the activity of the mind as

* Upon this point, the writer speaks from considerable experience, having taught a number of different schools, and some reputed to be very unruly and disorderly during eight or ten winters in succession without inflicting corporeal punishment upon a single scholar. By treating the elder and more advanced pupils with a sort of complimonable civility and politeness, and the younger with paternal kindness and gentleness, and avowing the determination to turn any one out of school, who should refuse, after suitable admonition and rebuke, to comply with certain rules and regulations, which were always written and read once or twice a week, he found no difficulty in reducing even very turbulent schools to a regularity, bordering upon that of military discipline. "Children are men and women in miniature," and if treated as such at school, and in the family circle, will, when fully grown, have a higher sense of their own responsibilities, and a better bearing towards their fellow creatures.

well as body, but on account of its immoral tendencies, it should never be employed in the education of youth. Although we may "be angry and sin not," yet the motives to action suggested by this passion are never magnanimous. Anger, by circumscribing and concentrating the energies of the mind upon a single object, neither enlarges the understanding, nor prompts to deeds of glorious memory. Was it the wrath of Xantippe, or the patient endurance and unflinching fortitude of Socrates, her husband, upon whose devoted head she once "rained an horrible tempest," that caused her name to be handed down to posterity through a lapse of more than two thousand years?

Love, when conjoined to hope, increases the powers of the mind; but it is the love of knowledge, and not of beauty, an affection for himself, and not for woman, which the teacher should endeavor to excite in the mind of the pupil, for the learner always makes most proficiency when fond of his instructor, and ardently in love with the science to be learned; because we are so constituted that we find no difficulty in fixing our thoughts upon that about which we love to think, or exerting ourselves to do that which is pleasing to the being whom we love. In regard to competition, emulation, rivalry, praise, profit or reward, we shall only observe with Sir Roger De Coverly, that much may be said on both sides.

ACTIVITY, AND SIZE OF ORGANS.

Phrenologists tell us that the power of an organ depends upon its activity and size; and if their doctrine that the brain is a congeries of organs, giving rise to certain faculties or manifestations of mind, be true, it then behooves us to search out the circumstances by which activity and size may be increased. It is a well known fact that exercise causes a greater degree of developement of the part exercised; in proof of which the arm of the blacksmith is often and familiarly alluded to; and this is explainable upon the principle that the performance of function causes a greater deter-

mination of blood to the organ performing it, and as the blood contains the material of which the organ itself is composed, the capillaries, whose business it is to construct and repair the organ, do themselves participate in the increased activity of those which perform its peculiar function, and in that way cause its bulk to increase *pari passu* with the increase of function. According to the doctrine laid down in this paper, all that is necessary in order to produce an increase of function is to cause the transmission of a moderately increased quantity of blood to an organ; and this will hold good whether it is an organ of motion, sensation or secretion; and we may add that the performance of function causes the requisite quantity of blood to be supplied in proportion to the demand, so long as the increased activity of the organ is kept up.

We shall now, for the sake of illustration, assume with phrenologists that the brain is composed of a considerable number of organs, which give rise to as many distinct faculties of the mind, and proceed to inquire how the principles, which have been laid down, can be applied so as to increase the activity and size of the respective organs. The main principle, it will be recollected, is, that an increased quantity of blood must be determined to an organ in order to increase its function and size. As this part of our subject more particularly regards the intellect, which a man is supposed to have always about him, we shall pursue the investigation on principles purely intellectual, irrespective of those physical agents, as wine, opium, and other stimulants which have been hinted at, and which are sometimes resorted to for the promotion of mental activity; but which may not always be at command; and if they were, should be avoided, because their effects are too evanescent to accomplish the object we have in view, and moreover tend to deteriorate and ultimately destroy the functions both of body and of mind. It becomes necessary, in this view, to advert again to the influence of attention in modifying the actions of the system. In a former part of this paper we have considered

its agency in the production of the voluntary motions, and showed that it was the principal or sole agent employed by nature to connect the will with certain muscles termed voluntary, and briefly alluded, by way of analogy, to its power in enabling us to get a control over the actions of the capillary vessels of the brain, by which we were enabled to carry on voluntary thinking, upon any subject on which we chose to think. At present, as in the former instance, we shall contiue to employ the term attention not in its ordinary acceptation, but in its logical sense, which is, "the immediate direction of the mind to a subject."

Now the actions of the body are carried on in health so stealthily as not to awaken consciousness in the mind, and therefore, an individual so long as he is in perfect health, does not know that his heart beats, or arteries pulsate, or that the process of digestion, or indeed any other, is going on within his body. In health, the action of the heart is perfectly balanced by the resistance of the capillaries over the whole body; but if the attention be directed to and fixed upon any particular part, the minute vessels in that part, upon the principle, that the stronger external, effaces the weaker internal impression, forego their resistance, and admit more red blood, which not only exalts its sensibility, and therefore enables it to perceive impressions which before were imperceptible; but stimulates the vessels to an increased action, or resistance, which now becomes capable of awakening consciousness in the mind. If a person fix the attention upon any part of the body,* to any spot for instance, not larger than a sixpence over the knee-pan, if you please, which is, perhaps, more free than almost any other part, from vessels that pulsate, he will in a few minutes, especially if the experiment be repeated a few times, perceive a sense of throbbing, which had never been felt before; and every one is familiar with the fact, that when

* If the attention be closely directed to either hand, a change in the circulation, and consequently in the feeling of that organ will be immediately perceived

we see or hear a person cough or yawn, the attention is unconsciously turned inward, upon the throat or muscles of the jaw, we soon experience in ourselves the same sensations as were experienced by him who is the subject of our observation; to relieve which, the desire to cough or yawn becomes almost, and in some cases, quite irresistible. Even the sight of food will make the hungry dog slaver as was remarked by Darwin. Upon this principle, we explain the fact, that almost every medical student, especially if he be of a nervous or hypochondriacal temperament, feels in a greater or less degree, the symptoms of the diseases about which he reads, or upon which he meditates. A young gentleman, a student of medicine, called on me one evening, after hearing my lecture on dropsy of the chest, and asked my opinion as to the propriety of an immediate performance of the operation, for evacuating the water with which he was persuaded his thorax was filled. I explained to him the nature of his case, and heard no more of it. A moderate determination of blood to an organ, we have said, is all that is necessary in order to increase its function, and by increase of function, to augment its volume; and as we have seen that fixing the attention of the mind upon any particular part of the body, causes more blood to flow into that part, it follows that we may by this mode of procedure, increase at will the functions of the different organs in the brain, upon whose activity, the various faculties of the mind depend, and furthermore, that by increasing the activity of function, we come at length to augment the volume, size and power of the organs themselves.* As a proof that we possess this power of calling any faculty into action, by fixing the attention upon the site of its appropriate organ, I would invite a phrenologist, or any one acquainted with the locality of the different organs, to fix his attention upon the

* The author is quite confident that in some points the configuration of his own head has undergone a change, which he thinks has been effected by this process.

organ of individuality, and see if he does not find his mind instantly engaged in considering individuals, persons or things:—upon the organ of locality, time, form, size, weight, color, or tune, and see if his mind be not immediately employed in forming and considering ideas suggested by those several organs:—also upon the organs appropriated to the sentiments, as benevolence, conscientiousness, etc., and see if the same results do not follow: and moreover, I believe he will find that the same doctrine holds equally in regard to the propensities. Let him for instance, fix his attention on the organ of acquisitiveness, and he will soon be thinking of wealth, or devising the means of acquiring it:—upon destructiveness, and he will be rioting in bloodshed and slaughter: and if every individual in an assembly or crowd, were to fasten his attention upon his organ of combativeness, there would soon be quarreling, and perhaps fighting. To make use of this principle in the education of the organs, or the acquisition of knowledge, I would suggest that when we would get a complete idea of an object, let the organ of individuality be first invoked, in the manner proposed, next locality, next form, size, weight, color, order and number, and we shall have a perfect conception or notion of the thing itself, and also in most cases of its various circumstances, connections, relations, &c. We shall in fact have made a complete analysis of it, and when we would recall it for subsequent reflection, we have only to make the organs repeat the same actions, and the same complex idea will be instantly recognized as before the mind's eye. The various organs of the brain are rendered relatively active by an impulse from within, i.e. an increased determination of blood to them, and then they will form the ideas which are congenial to the function of the organ rendered thus active. This mode of activity the phrenologists term conception, and is nearly allied to fancy, or imagination; and differs from memory in this, that the ideas suggested in this way are independent of the will, whereas in exercising the memory upon any subject which had been previously in the mind,

we have only to make the same organs by an effort of the will perform the same actions as were performed by them in the first instance, and then the same ideas, and the same trains of thought will pass through the mind.

EDUCATION OF THE SENSES.

The following remarks upon the education of the senses will conclude the subject. As the senses are the primeval inlets of knowledge—the savans that collect all the materials which are to furnish employment for the mind during its sojourn in its tenement of clay, the importance of the subject would seem to challenge more time, attention, and ability, than we can give it; but we entertain the hope that it will commend itself to some one who will do it ample justice. It is said that the senses of smell and taste, furnish no materials for the mind to reflect on. If "perfumes as of Eden flowed sweetly along"—if ambrosia or nectar, the fabled food and drink of the gods, rested upon the tongue, neither the exquisite flavor of the one, nor the enchanting aroma of the other, would leave an impression that could be recalled for the scrutiny of the mind.* Placed as these senses are at the entrance of those passages through which food and air, the extraneous substances essential to our physical existence are admitted, they seem designed by nature to perform the office of sentinels to advise us that substances hurtful or offensive to the body are present; and which if permitted to pass these portals of the system, may disturb its economy, and ultimately dislodge the immortal resident,—therefore, as soon as the danger is past, they are of no further use. This surely is in perfect accordance with the frugality of nature, which does nothing in vain;—never comes short and seldom exceeds. In the education of

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Comb in his Essays, on Phrenology, says:

* "The functions of this sense, (taste) are to produce sensations of taste alone and these cannot be recalled by the will. The functions of smell are confined to the producing of agreeable or disagreeable sensations, &c. These cannot be reproduced by an effort of the will."

the senses, I am persuaded that an important principle has been overlooked, and consequently a great error committed by neglecting the consideration that they are all in the performance of their functions, connected with muscles, whose actions are cognizable to the mind, and in a greater or less degree under the control of the will, and that without due attention to this fact, the education of the senses can never be perfected. In regard to the sense of smell, no odor is perceived, however strongly impregnated or even saturated, the atmosphere may be with its effluvia, unless the muscles of respiration are called into action, and inspiration takes place, as in ordinary breathing, involuntary it may be, or voluntary as when we smell of a substance, with a view to ascertain its peculiar odor, or to make some nice distinction, or to enjoy the voluptuousness of some particular fragrance. It is averred by some whose sense of smell has been cultivated, or rather educated, that they can recall the odor of any substance which they have examined in this way, and reflect upon it as they can upon any other sensation. This I doubt not, is almost, if not entirely the result of education; for with many persons, and I have reason to believe, with a great majority of mankind, it is not so, owing to their having neglected to bestow the same attention upon this sense, as upon those of sight and touch. If this sense is to be educated, it must be done as in all other cases, by the efforts of the will. We must first desire knowledge; then labor for its attainment. Much the same views hold good in the regard to the sense of the taste. That sense remains dormant, unless the muscles connected with, or subservient to it are put in action. For instance, if the mouth be opened, and a piece of sugar, or a piece of aloes, the diagonals of sapidity, be put upon the tongue, no other than a mere mechanical impression, will be made upon the organ of taste, no flavor will be perceived so long as the tongue is kept motionless: but the instant the slightest movement is made, the characteristic taste of either will be perceived, and the only way in which this sense, like that of smell, can

be educated, is to fix the attention upon the tongue, and then cause it to perform motions as in tasting, and to notice those particular motions in each individual case or experiment, and when the substance tasted, is removed, if we would recall the perception of its flavor, we must cause the tongue to perform again the same motions which it did, when the sapid body was present, and again the peculiar flavor of the substance tasted will be perceived.* In this manner the sense of taste, as well as smell, is brought to such exquisite perfection, as in the case of cooks and apothecaries, that they are enabled to analyze by the odor and flavor, the most complicated dishes and medicines with all but chemical accuracy.

EDUCATION OF THE EYE.

This noble organ is a perfectly formed optical instrument, endowed with vitality. Its external shell is composed of the cornea and sclerotica, the former, situated in front, is perfectly transparent for the admission of the rays of light, and is also more convex, which augments its converging power. The centre of the cornea corresponds to a small circular spot or foramen in the posterior part of the retina, (foramen centrale, or foramen of Soemmering, so called from its discoverer,) whose margin in the perfect eye is of a bright yellow color, and in whose centre is the appearance of a hole about the size of a pin's head, which is according to Ammon, a mere depression of the surface of the retina occasioned by the more intimate union at this point of the choroid and retina by the intermedium of vessels, and is consequently, according to the doctrine laid down in this treatise, the most sensitive part of the retina, the sensibility of a part being in proportion to its vascularity. This minute central point of the foramen receives that single pencil of light which strikes and enters the centre of the cornea perpendicularly to its surface, and passes on in a direct line to the point above-

* It will be necessary to repeat this experiment on the taste, and also on the smell, a great many times, before the result above mentioned, will be obtained.

mentioned, (the foramen centrale,) without being at all refracted in its passage through the denser media of the cornea and humours. A line passing through the centre of the cornea at a right angle with its external surface, and terminating in that foramen, may be called the axis of the eye, or the axis of vision, as it may be referred to in relation to the organ itself or its function, and which is always directed with great exactness towards the object or point looked at. The point in the object at which we look, and from which the pencil of light entering the eye in the manner just described is reflected, is the most luminous, and consequently most perfectly seen, and therefore, may be termed by way of distinction, the point of vision. It is indeed the only part that is seen with perfect accuracy: and this is as it should be: for, as we can attend to but one thing at a time, nature designed that we should see perfectly one thing only at a time, but as every object upon which we look, or upon which the eye rests, is composed of parts, or surrounded by other things, it was no less the design of nature that while the eye was busied with a single point, light reflected from other points about it, should be admitted into the organ, and make impressions upon the retina in the vicinity of the foramen of Sœmmering, which, although faint, compared with those made upon the foramen itself, were nevertheless, sufficiently strong, to acquaint the individual with their existence, and to excite in him a desire to examine them: a desire which will prompt him to move the eye, and direct the axis of vision to and successively over every part, that all portions may be seen and examined with the same accuracy. When, therefore, we would see an object in the most perfect manner, and get a complete idea of it, we must move the eye, so as to carry the axis of vision over every part of it: and when this is done with suitable care and attention, we can hardly fail of getting a correct and complete notion of it, comprising all its parts and properties, as color, shape and size, and in fact, of its relations to, and connections with, other things. If the thing

surveyed, be large or complex, it may be analyzed or divided into parts, each of which in succession, may be examined in the same manner. Thus, the eye may be educated, and made capable of increasing to an inconceivable degree the amount of knowledge, exact and definite, that may be acquired through the medium of this noble sense, which seems to confer on man a sort of ubiquity, that enables him to take cognizance of every object within the circle of his vision, as if in his immediate presence. Without an apparatus of motion, the eye, though a perfect optical instrument, would be of little use, because when immoveably fixed for any considerable time on any object, even the point of vision becomes more and more dim and obscure, until the power of perception is entirely lost, and the organ, so far as that particular object is concerned, is useless; but the slightest movement restores its power. This accords fully with a law of the system, which has been already adverted to and explained, to wit: that a part to which a stimulus has been constantly or repeatedly applied, loses its susceptibility to that particular impression.

Besides being an optical, the eye is also a mathematical instrument. It is the quadrant which the God of nature has bestowed on man for the purpose of enabling him to calculate heights, distances and magnitude, by simply noticing the degree of contraction exercised by certain musles employed in carrying the axis of the eye and of vision from one object to another: or from one part of an object to another part:—or of lengths and distance, by carrying it from one end of a thing to the other;—or from place to place. Without the trouble of making actual admeasurements, the well educated and experienced eye is capable of making all these estimates, with an accuracy sufficient to answer all the ordinary purposes of life, and which, with extraordinary cultivation, will fall very little short of mathematical certainty. The joiner or carpenter, for instance, who has been in the habit of measuring with the eye, will tell you at a glance the length of a piece of timber as correctly as a careless

measurer would do with his rule, and the experienced eye of the engineer enables him to judge with astonishing accuracy of the height or distance of an object without his sextant or quadrant. I once knew a tailor, noted for his good fits, who had brought this power of measuring by the eye to such perfection, that he seldom, if ever, had recourse to his measure for the cut of a coat; as an evidence of the fact, he cut the uniform coats for a whole company of infantry, belonging to the town in which I resided, without a single failure, or even an indifferent fit. He required but a minute's survey of each soldier. Brown, the celebrated cutter of full length profile likenesses, is another example in point.

The eye takes cognizance of the color, size, height, distance and relations of things. As color has little utility in the great system of nature, we shall confine our remarks mostly to the manner in which height and distance, shape and magnitude are judged of through the instrumentality of this organ. Without finding fault with the explanations of this matter given by others, we shall bring forward a theory, (perhaps, we should rather say, hypothesis,) for which we will bespeak a candid consideration, and only ask that it should be taken for what it is worth. We ought to premise that the people of civilized nations, have by convention or law, established certain measures or standards for the admeasurement of space, and the magnitude of the things which it contains; and we believe that the mind, in judging of these matters by the eye, does so by noticing the degree of contraction exercised by the muscles, employed in carrying the axis of vision from one designated point to another, or from one end to the other, of one or another of these established measures or standards. For instance, we learn to judge of a foot, or yard, with the eye, by fixing the axis of vision on one end of a twelve inch rule or a yard-stick, and then carrying it to the other extremity, taking care to notice the degree of muscular contraction necessary to effect this; or of an inch, or any other fractional part of the measure, by carrying the axis of vision from one point to another.

When this has been practised upon for a little time, the mind has obtained a standard which approximates to accuracy in proportion to the number of times, and degree of attention with which the experiment has been tried. This standard and mode of judging are acquired unconsciously in early life, and in a manner which has, perhaps, never been thought of in our riper years. In the same way, standards for greater distances, as rods, furlongs and miles, quarters or halves of miles, are acquired. In order to a correct understanding of the theory we propose, we should premise that there is a point upon which the axis of vision always rests, and from which it imperceptibly, but we believe, invariably starts when the eye is about to commence its survey for the measurement of the height, distance, or magnitude of any object. This point, we shall endeavor to ascertain. The position which an individual in an erect posture naturally assumes, is that, in which all parts of his body are so perfectly adjusted, with reference to the centre of gravity, that the erect position is maintained with the least possible exertion of the muscles, and we may conceive of the possibility of this adjustment being so perfectly accurate, that the perpendicular might be maintained without any voluntary muscular effort whatever. The power and the habit of this adjustment, were acquired unconsciously in infancy and early life, and are constantly practised upon in riper years, to the end of our being, with a mere consciousness of the fact, that we possess them. Again, the spontaneous action of the muscles attached to the eye-ball of a person in the position just described, would, in the absence of all volition, bring the axes of the eyes to correspond in direction with a horizontal line, crossing the perpendicular at right angles, so that the axis of vision will fall upon an object which is exactly on the same level with the eye. To illustrate: suppose a person situated on an exact level, and in the posture just described, with his eyes just five feet above that level, the axis of his vision would spontaneously rest upon a visible object at the same altitude with the eye,

i. e. just five feet above the level. The truth of this proposition is not in reality at all affected by the distance which intervenes between the object and the eye, although, from the process of foreshortening it, may be apparently so. In relation to this *point d'appui* of vision, another consideration presents itself, which is, that the "globe or ball of the eye is not exactly spherical; the line forming the visual axis exceeds its transverse diameter," and "is parallel in the two eyes," consequently, an object cannot be looked at with both eyes at the same time. Although it may be simultaneously perceived by both, one eye only looks at, sees and notices it. This however, holds true only in regard to a certain distance: for, notwithstanding, the correspondency of the axes of the eyes, yet, when all volition is suspended, the spontaneous action of the muscles of the eye balls will produce a concurrence of their axes, and cause them both to rest upon the same object, if placed at a certain distance from the beholder, and it is then, and then only, that it will be looked at and seen, at the same time by both. From numerous experiments, we are convinced that this distance, at which an object is seen simultaneously with both eyes, is about forty yards, or from forty to sixty, varying somewhat in different individuals, as the space between their eyes varies. Let a person facing the south, be placed on the level as before described, whose eyes are exactly five feet above that level, with his mesial line, (i. e. that line which divides the body into two equal halves, right and left, and consequently, is exactly midway between the eyes,) corresponding with the meridian, and let an object just large enough to be seen, be placed at the distance of eight rods from the eyes, and on the same horizontal level, and at the point where this line is intersected by the meridional line afore-mentioned, and it will be found that the axes of both eyes will come to rest concurrently upon it, by the spontaneous action of the muscles of the ball independently of all voluntary effort to bring them to this point, or to produce this result. That, then, is the *point d'appui*, upon which the axis of vision

rests, and from which we believe, as before suggested, it starts when the mind is about to consider any object with the view of judging by the sight of its distance, height, shape or magnitude, and in so doing, it notes the degree of contraction made by said muscles, in carrying the axis of vision from that point to the base and summit of the object, when it would ascertain its height, or judge of its altitude; also the degree of contraction necessary to carry the said axis from the aforesaid *point d'appui*, laterally from right to left, in order to ascertain the length or breadth of the object, and for ascertaining its shape as well as size, the mind noticing the degree and modification of the contractions of the several muscles, as they cause the axis of vision to trace the contour or outlines of the things of whose shape it would form an accurate conception.

Again: in front of a person, situated as has been just described, place a rod, five feet long, perpendicularly, so as to correspond with the mesial line, and the axis of vision can be readily brought to the lower extremity of the rod, (which is also just five feet in advance of a line dropped from the eye,) by a voluntary effort of the inferior straight muscle, without the slightest inclination of the head. If the axis be now made to pass up and down from one end of the rod to the other a number of times, the individual all the while, carefully noticing with what degree of contraction the muscles act in order to accomplish this, will soon have acquired a standard of measurement, by which he can judge of and ascertain the height of any object at the distance of five feet from the eye. If the rod be now removed to the distance of twenty feet, and made to assume the same position, and if the axis of vision be made to pass from the place occupied by its lower extremity, to the point where it now rests, and this process be many times repeated in the manner aforesaid, he will have a standard of admeasurement, by which he will be enabled subsequently to judge with considerable accuracy, when the axis of the eye has been carried through the space of twenty feet on the same

level. He may now fix the axis of vision upon the lower extremity of the rod in its new position, and carry it upward until it rests upon its upper end, and by a few repetitions, he will find how much the muscles must contract in order to make the axis pass through the space of five feet, at the distance of twenty. In this way let the pupil be schooled, and in a short time he will acquire the power of measuring distances, and judging with wonderful accuracy of height and dimension in all directions, and at every ordinary distance within the customary field of vision. It is believed that every one, from the infant, sitting or standing upon the floor,* to the tallest Anakim in the land, has a *point d'appui* of his own, which depends upon the distance of his eye above the afore-mentioned level.

The use of the eye is commenced in early infancy, and its education, if it be proper to employ that term in this connection, is carried on in the way which has been indicated, until the power and the art of measuring and observing has been acquired before the learner was aware of the manner in which this sense had been educated; and perhaps many people pass through a long life ignorant of the fact that they possess this power, and above all that they had had any agency in its acquisition, supposing all the while that the judgments they formed were intuitive, and that the knowledge resulting from the employment of this sense also came by a sort of intuition. Let the attention of the child and the pupil be directed to this subject by the parent and the teacher, and let him be made to practice daily upon the principles suggested, and the results ascertained and tested by the actual application of the standards in use among the people, and it is the firm belief of the writer that pupils in a certain period will possess a much greater amount of knowledge, as well as stronger and far more comprehensive

* In whatever posture the body may be, it is believed that this fixed or starting point of the eye always exists, and is that to which the axes of the eyes are brought by the spontaneous action of the muscles of the globe.

and active minds, than they would have had if this kind of culture had been neglected. If this belief be well founded, then let the method be tried in all our schools, and its practice be enjoined upon the scholars when out of school; and also let it be adopted and practiced upon by every individual in the community, and the writer ventures to think that all who make the attempt, and follow it up perseveringly for a considerable time will be not only gratified, but astonished at the facility with which the eye furnishes the mind with clear, strong and complete conceptions of things. The gratification will more than compensate for the trouble; indeed the eye will soon do its work without trouble or effort. Conceptions, clear and strong, will seem to come as by intuition. If complex, embracing great objects, compounded of many parts;—or prospects comprising many different things, those parts and things will be conceived and judged of in their places and relations, without those movements of the organ to which we have alluded; also the relative distances between the various parts and things will be settled in the mind by simple inspection, because we know, having learned by experience, how much the muscles of the eye must be made to contract in order to carry its axis from part to part, or from one thing to another. In this way we explain the fact that we often get complex notions, and measure distances without moving the eye. (See page 45.)

In conclusion, I will add, that in no way is the accuracy with which the axis of the eye is directed to a point, and the corresponding accuracy of adjustment of the contraction of the muscles connected with the limbs so well exemplified as in the art of gunnery. In the shooting line, the feats of Mr. M. James, my neighbor across the way, who is the best manufacturer of rifles in America, and probably the best marksman with that kind of gun in the world, are wonderful, if not marvellous. In gunnery, and military and civil engineering, the education of the visual organ is of national importance. • If the eye of every soldier, marine and gunner in the United States Army and Navy was perfectly

educated, they would be terrible foemen to the enemies of the country. Nor is this the only respect in which the education of the eye is of national importance, for show me an artisan whose eye has been schooled to perfection, and I will show you a perfect handicraftsman. It is hardly necessary to say, that the eye of the medical man, especially if he be a surgeon, should be well educated.

OF THE SENSE OF HEARING.

Hearing is the sense by which we perceive sound. The ear, or more strictly speaking, the auditory nerve, is its appropriate organ—the vibrations of the air its physical cause. It has been observed in a former part of this paper, that every organ is so constructed, or in other words its structure and organization are such, that if it act at all, it will perform its own legitimate function, and nothing else. I now observe that the arrangement of the auditory apparatus is such, that if action be excited in the acoustic nerve, either at its termination in the labyrinth, or its origin in the brain, or indeed in any part of it along its course to its destination, sound will be produced; hence it is that vibrations of solids or fluids, or mere changes of circulation in the auditory apparatus, in the entire absence of the true physical cause, are capable of producing sensations of sound; as is proved by the noises in the ear which are so often complained of by patients, and especially those afflicted with that species of deafness which is termed nervous. From the action and changes of action in the organ of hearing the mind derives all its ideas of sound; but simple audition does not in man, as in many animals, comprize the whole function of the organ, which, like the other organs of sense, is capable of being greatly improved by education. So far as educational purposes are concerned, reference is to be had mostly, if not exclusively, to those sounds which are caused by the vibrations or undulations of air impinging on the membrana tympani, or drum of the ear. The importance of this sense, and of its education, can not be duly

appreciated, without taking into consideration the fact that upon it the faculty of speech depends. Without it the language of the voice, and consequently one of the fine arts, the one most capable of enrapturing the soul, could never have existed. Without the "concord of sweet sounds," the joy of heaven would be defective.* The education of this sense, it must be admitted, is of the highest importance: but from the obscurity of the subject, its education has been left either to nature, to the individual efforts of each person, or almost entirely neglected. At all events, the principles upon which the success of educational exertions depend, do not appear to have been well developed or satisfactorily settled. The principle which we shall assume in regard to its education, is the same as that assumed in the education of the other senses, to wit, muscular contraction. We hold that in this respect the analogy extends to all the senses, for with each of the five, muscles are connected upon whose action their utility as instruments of intellection is based.

The muscles connected with the sense of hearing, to which we have alluded, and which are attached to the chain of bones extending from the membrana tympani, or drum of the ear, to the foramen ovale, are the tensor palati, laxator palati, and the stapedius. These muscles, thus situated and attached, are primitively, as well as consecutively affected by every motion communicated to those little bones, by the vibrations of that membrane, produced by undulations of the air, or any other physical cause, and from that circumstance are compelled, so to speak, to take cognizance of every kind and degree of movement which those bones are made to perform. These changes in the state of those muscles, produced by the physical causes just alluded to, and modified by the properties peculiar to each, sooner or later awaken consciousness in the mind, and at length the desire

* The ear is susceptible of such exquisite cultivation, that a devotee of music once assured me that he would be willing "to lie at hell's dark door," could he only hear the music of heaven.

for their repetition in the absence of the cause which occasioned them, and by repeated trials the individual finally acquires the power of reproducing them at pleasure; thus the control of the will over the action of these muscles is acquired in the same way as it is acquired over all the other muscles which are considered voluntary. When this ascendancy over those muscles has been obtained, they can by an effort of the will be made to act or relax, just as they did when influenced by this or that physical cause, and an idea of the same sound will arise in the mind, as well in the absence as in the presence of the particular cause. For instance, when a person wishes to call to memory a particular sound or the notes of a tune, he has only to make these muscles act so as to move the bones just as they were moved at the time when the sound was made, or the tune sung, and the same sounds will be recognized. The musician, when his eye falls upon a note or a series of notes, will cause these muscles to act and the bones to move, just as they did or should act and move when these notes were struck, and in this way will be able to think over a tune or piece of music as well in the absence as in the presence of the physical cause. In this way, if, when we hear a noise or a voice for the first time, we have been attentive to the changes which have taken place in the ear, we shall be able by an effort of the will to re-produce the conception. But these are not the only muscles which may subserve the function of hearing, and which should be considered in the education of this sense. The muscles connected with the ossicula give us no ideas of the direction in which sounds come: a very important part of the knowledge to be derived from the faculty of hearing. Of this more hereafter.

In a former part of this paper, it has been remarked, that our sensations were essentially modified by the physical properties of the agents operating upon the senses, and furthermore, that this was also indispensable; for without it, one sensation could not be distinguished from another. As the physical properties of the several substances are al-

ways the same and identical, it follows, that aloes is always bitter, and sugar always sweet, and that, therefore, there can never be any difficulty in distinguishing them; and the same principle holds in regard to the capability of physical bodies, to modify the undulations or vibrations of air, and consequently, the sensations produced in the ear, furnish the same certainty of discrimination, as is done by the other senses, and upon this power of discrimination, depends in a great degree the real utility of this sense, whose final end is to enable us to apprehend the existence of agents which are not cognizable to the other senses, and likewise, to distinguish them one from another; and to determine their distances and positions, relations and situations in respect to each other, and to ourselves. A knowledge of the existence of certain bodies or agents, by the sense of hearing, depends upon their capability or power of exciting undulations or vibrations in the media, with which they are connected, and which are capable of producing some change in the state of the auditory nerve: and the power of discrimination, as has been observed, depends upon the manner in which those undulations or vibrations are modified by the physical properties of those agents.

OF THE MEASUREMENT OF DISTANCE BY THE EAR.

Individual safety, as well as other important considerations may depend on our knowledge of the distance which intervenes between us, and the bodies causing the sound. Intensity of sound seems to be the principle of admeasurement by which the distance of a sonorous body is ascertained. The vibrations or undulations of the air, impinging against the membrane tympani, constitute the physical cause of sound, and the impulse communicated from that membrane to the auditory nerve, through the medium of the chain of bones with which it (the membrane) is connected, is its proximate cause. Now, the muscles attached to the ossicula, or small bones of the ear, experiencing a change in their state of tension, take cognizance of the mo-

tion which these bones are made to undergo, and being endowed like other voluntary muscles with nerves, which not only confer on them the power of motion, but the faculty of transmitting to the brain, the organ of mind, a knowledge of the changes in their condition they excite in the mind a consciousness of those changes. The stronger the impulse, the greater will be the extent of the motions of the ossicula; and as this degree of motion in those bones, is measured and judged of by the influence or effect which it has on those muscles, a man is, in this way, furnished with means by which the intensity of sound, as a measure of distance, is determined.* The principle upon which this depends is, that sound in its distribution throughout a larger

* Nature, no less bountiful in her resources, than simple in her operations, always take care not to be balked in her purposes, and has therefore, in order to secure against the failure of functions of vital importance, furnished us with double organs, and in like manner she has not, in relation to the intensity of sound, confined the mode of judging solely to the muscles, except in cases in which great nicety is required; but has so constructed the organs of hearing that vibrations shall be communicated to the auditory nerve by means of the membrane which subtends the fenestra rotunda, whose oscillations are it is believed, capable of exciting the nerve, not only in the presence, but in the absence of the membrana tympani; nor has she been satisfied with this, but has superadded another method by which sounds are perceived and their intensity judged of. The bony labyrinth is lined by a membrane or sacculus which encloses the liquid called the perilymph. The auditory nerve is distributed upon this membrane, and in contact with the bony cavities which surround it. Now sonorous vibrations are, as is well known, communicable through solids, as well as through aeriform or fluid bodies, and hence it is that the nerve receives impulses communicated to it by the solids with which it is in contact, and takes cognizance of them, but with much less accuracy, just as if they had been imparted by vibrations whose force has been spent upon the fluid contained in the aforementioned membrane or sacculus, through the chain of bones, as has been described. In consequence of these superadded arrangements, we should be enabled to judge with some degree of accuracy of the distance of sonorous bodies, by the intensity of the sound even if in case of accident we were deprived of the membrana tympani, and all the ossicula. I have myself seen several persons who had lost those important parts, but who would nevertheless hear tolerably well, and if I rightly remember could distinguish musical sounds. If I am not mistaken, a lad similarly situated informed me that he could sing some tunes. With what accuracy these persons could measure distances by the ear I cannot say, as it has not occurred to me ever to make that point a subject of investigation or enquiry.

and still larger quantity of matter diminishes as it diverges in every direction from the point at which it originated, and the rule of diminution, is in proportion to the square of the distance from the centre. For instance, the velocity of the particles of the medium by which sounds are conveyed, is less by one hundred at the distance of ten feet from the sounding body, than it is at one foot.

We judge of distance, by the ear, upon another principle, to wit: the reflection or reverberation of sound. When this is perfect, we have the echo: which depends upon the distance, and this must be such, that to obtain a distinct repetition, the reflected sound shall not arrive at the ear, before the perception of the original sound has ceased; otherwise, the resonance will be indistinct, a mere noise. We, no doubt, learn to judge of distances by the reflection of sounds, which are not, as in the echo, distinct; but in what manner, it is difficult to explain. We do it as in many other instances, by experience, obtained and practiced upon at an age too early to have been noticed with sufficient attention, to be recollected and explained in subsequent years; although we may habitually act upon it many times during almost every waking hour. It is, most probably, in this way, that blind people acquire the faculty of judging of the dimensions of a room by the sound of the voice. Dr. Darwin, was the first who suggested this idea. Taking the hint, from an anecdote related in his Zoonomia,* I have availed myself of almost every opportunity which presented itself, in the course of an extensive practice in ophthalmic surgery, for the investigation of this curious subject, and have been often amused, and sometimes astonished at the accuracy with which the blind judge of distances by the ear, and especially the size of the different apartments of a building: but I believe this power is possessed by

* "The late Justice Fielding walked for the first time into my room, when he once visited me, and after speaking a few words, said 'this room is about 22 feet long, 18 wide, and 12 feet high;' all which he guessed by the ear with great accuracy."—*Darwin's Zoonomia.*

those only who were not born blind, or who lost their sight in very early life. "The resonance of rooms," says Arnott, "depends on this continued reverberation,"* and this remark furnishes the principle upon which this method of judging is founded.† By the cultivation of this sense, as in the case of the blind, we are enabled to distinguish with considerable accuracy the resonance of reflected sounds; and in fact I have no doubt that in ordinary life, without more than the common degree of culture, we practice continually and successfully, although unconsciously, upon this same principle in judging of distance by the ear. Having learned by experience to distinguish sounds one from another in consequence of their being modified by the physical properties appropriate and peculiar to each cause, we at the same time, likewise, learn the force of sounds thus modified at the distance of one, two, or ten rods, &c.; and at length we come to judge, with considerable accuracy, of the distance of the cause which produces this or that particular sound or noise, as modified by space: and the more familiar we are with particular sounds, the more accurately shall we judge of distance by their means.

There is one other consideration which should perhaps be

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* "It is worthy of remark, that every apartment or confined space has a certain musical note proper to it, the character of which depends upon the number of pulses or repetitions, of a sound produced in a given time by the returns from its walls. The velocity of sound being uniform, this number must depend on the size of the apartment."—*Arnott's Physics.* These pulses or repetitions of sound are no doubt much more accurately perceived and distinguished by the blind, whose other senses and especially that of hearing, have been cultivated with such care as to make amends in some degree for the loss of sight.

† If the distance intervening between the sonorous body and the surface by which the sound is reflected be less than 45 or 50 feet, the direct and reflected sounds will be blended, and the more so the nearer the reflecting is to the sonorous body; and consequently the nicer and more cultivated must be the ear by which these sounds can be distinguished so as to draw any just conclusions as to distance. If less than one twelfth of a second of time intervene between the hearing of the direct and reflected sounds, there will be no distinct echo; but a mere resonance; but if more than one twelfth of a second intervene, there will be no resonance, but a complete echo.

taken into the account in connection with this part of our subject, to wit: the effect which the vibrations of the membrana tympani, and the movements of the ossicula have upon the chorda tympani, a nerve connected with the tendon of the stapedius muscle, and also with the long leg of the incus, and the manubrium, or handle of the malleus, to which it is so very closely attached, and that too so very near its centre of motion that no movement in the latter can possibly happen which does not affect this nerve. It should be recollected, moreover, that the above-mentioned nerve also passes near the insertion of the tensor tympani into the short process of the malleus, and furthermore that it makes its exit out of the cavity of the tympanum in company with the musculus externus mallei.

DIRECTION AND SITUATION OF SONOROUS BODIES.

Nature, although bountiful in her gifts, is chary in the bestowment of them under circumstances in which they could be turned to no good account by the recipient. No benefit could inure to the infant to be able to judge of the distance and direction of sonorous bodies before he possessed the power of avoiding such as might be hurtful, or of apprehending and appropriating such as might be useful or pleasing: hence he has been left to learn by experience how to acquire this important faculty of judging of the distance and direction of the causes of sound. It is, however, to be regretted that in the case of nearly every individual the education of the senses has been allowed to go on *pari passu* with their employment, altogether independent of any special effort for their improvement; while it has been known to every observer that they were susceptible of the highest degree of culture: as in cases where persons bereft of one sense, have by cultivation brought another to such perfection, as to become almost a substitute for that of which they had been deprived. Is not the education of the senses, (the primeval inlets of all our knowledge,) a subject too important to be left to chance, or undirected, unassisted individual

effort? or should it not rather have a place in all our systems of education, especially such as are elementary?

As in vision, although light is received into both eyes, yet we look at and see an object with but one, unless it be placed at a distance of more than 10 or 50 yards, and in a position corresponding with the mesial line of our bodies; so, in hearing, sound is received by both ears, but perceived by one only, unless the sonorous body be located either directly before or behind, and in strict accordance with the line above mentioned; or in other words exactly equidistant from either ear; in which case we hear the sound equally with both, but we can not tell from what direction it comes. When the cause of sound is on either side of the mesial line, and especially if a little distance from it, it is heard best by the ear to which it is nearest. In the eye, a line drawn from the centre of the cornea, at right angles with its surface, to the foramen of Soemmering constitutes the axis of the eye, and a ray of light reflected from an object, which enters the centre of the cornea at right angles with its surface, and passing on unrefracted to the aforesaid foramen, may be said to be the axis of the eye, or of vision: so in the ear, a line passing directly from the sonorous body through the middle of the external meatus to the point in the centre of the membrana tympani at which the extremity of the handle of the malleus is attached to that membrane, constitutes the axis of the ear, or of hearing in reference to function, and a ray of sound passing from the sonorous body and entering the meatus in the same direction, and impinging upon the same point of connection between the handle of the malleus and the membrana tympani, will make the strongest impression upon the auditory nerve, and consequently will cause the clearest audition. This point of attachment between the handle of the malleus and the membrana tympani is to the ear what the foramen of Soemmering is to the eye. Because sounds entering the ear in this direction are best heard, we turn the head one way or the other, until the axis of the ear is directed exactly to the place

whence the sound proceeds, and which is instantly recognized by an ear that has been only slightly trained. When that has been accomplished, we are no longer in doubt as to the direction of the sonorous body. This is the true attitude of listening, especially when we are anxious to catch or discriminate any certain sounds, or to apprehend them for some definite purpose. I have no doubt we have the power of judging of the direction and situation of sonorous bodies by the echo or reverberation of the sound, and likewise by its resonance; but this is perhaps but seldom attempted with much success except by persons whose sense of hearing has been educated and considerably practised in this respect. It is, however, undoubtedly true that every person is constantly though unconsciously practising upon this principle, which is based on the fact that in sound, as in light, the angle of reflection is always equal to the angle of incidence. It is exceedingly probable that reflection of sound by the external ear, and its resonance in the meatus, as well as its reflection from surrounding bodies, have an important bearing upon this branch of the function of hearing. The wave of sound, acting upon the column of air occupying this passage, puts it in motion. If the axis of this column be at right angles with the circumference of the wave of sound, the strongest impulse will be on that portion of the membrana tympani which is attached to the extremity of the handle of the malleus; but if the axis of this column of air be oblique to the circumference of the wave, the impulse will be communicated to some portion of the elastic walls of the passage, and reflected perhaps again and again before it impinges upon any part of the tympanum, or drum of the ear; now as sound, like light, travels through the air in straight lines, we learn to follow back, so to speak, these reflections of sounds, and in this way to form a judgment, imperfect it may be, of the direction of the causes which originated them. When a sound is heard, which has been heard before, perhaps many times, and sometimes in the attitude of listening, i. e. in the direction of the axis of the ear, so that an idea of it and also of its physical cause has been under

such circumstances formed, we have then in the mind a standard with which it is at every subsequent hearing compared, and when a difference is found to exist between the conception of the re-hearing and the hearing on a prior occasion, and having likewise learned by experience, that this difference is caused by difference of direction only; we change the position of the ear so as to admit the sound in a line which corsponds with its axis,—when the judgment in respect to the direction and situation of the sonorous body is immediately settled. It is altogether probable that we are, in the first instance, led to attend to the direction of sonorous bodies, very much in the same way as we are to that of visible objects, and that the principles of judging are the same in both cases, to wit, muscular contraction. To be a little more particular: when the axis of vision is fixed on a point, other objects in the field of vision will be discerned, though less perfectly seen, yet with sufficient clearness and distinctness not only to inform us of their existence, but to excite curiosity and prompt the individual to turn the axis of the eye upon them in succession, for the purpose of examination. The same, to a certain extent, holds in regard to the ear. Sounds are heard in various directions other than that of the axis of the ear, yet with a distinctness which, as in the case of vision, prompts the individual, especially in early life, to alter the position of the ear in order to get a more perfect conception. This method soon becomes habitual, and is continued through life. In this way we are induced primarily to attend to the direction of sound, and to form judgments concerning it. In regard to the training and practice, the analogy between the eye and the ear holds with considerable strictness. In seeing, we judge of the direction of objects without moving the eye, because we have learned by experience how much the globe of the eye, or in some instances the whole head must be turned; in other words, how much this or that muscle, or sett of muscles, must be made to contract in order to cause the axis of the eye to be directed to an object whose reflected light enters the eye in a direction divergent from its axis; so in hearing

when sounds enter the ear in a direction different from that of its axis, having learned from frequently repeated trials how far the ear must be moved that its axis may correspond with the direction in which the sound comes, we judge of that direction without moving the organ. It should be constantly borne in mind, that in our physical organs, as well as intellectual faculties, improvement is the sure reward of exercise, and that exercise is the essential pre-requisite, the *sine qua non* of improvement in both; and furthermore, that improvement will be nearly in proportion to exercise. The exercise and education of the senses, and especially that of hearing, the anatomical structure of which seems to be perfect at birth, should commence in very early life, and be carried on in the nursery, the parlor, and the public school-room, under the direction of the parent or public teacher. The child or pupil may be hoodwinked, and various articles of different metals and components, as glasses, tea-cups and saucers, bowls, pitchers, &c. &c., of different sizes and in different directions, may be struck, and the learner called upon to designate the article, and to judge of its size, direction and distance from the ear. The walk or step of different persons; the kind of carriages or vehicles passing in the streets, whether they be loaded or empty, and the kind of loading, &c., may be made questions to exercise the ear and judgment of the pupil. In these, and a thousand other ways which the ingenuity of the parent or teacher will suggest, this sense may be cultivated and improved. The habit well established in childhood, will be continued, and the hearing perfected in after life, to a degree of which very few have any just conception. As an ear attuned to music, is capable of ministering so greatly to the happiness of mankind; and as almost every child whose ear has been duly educated, may be taught to sing,* or at least, enabled to

* The power of the will over the muscles which modulate the tones of the vocal organ, is acquired as in the case of the larger muscles, which are by common consent deemed voluntary. The process is in both cases the same, and has been detailed on page 20 and 21. It is applicable to the education of the voice.

experience the delight which is awakened in the soul, by a "concord of sweet sounds," great pains should be taken to educate the ear for the perception of musical sounds, but being so unfortunate as not to have an ear for music, the author is incapable of giving any directions for the attainment of that object. However, he indulges the hope, that the time is not far distant, when music will be taught in all the elementary schools in this, as it is in other countries, especially in Germany.

OF THE SENSE OF TOUCH.

Anatomically and physiologically considered, the philosophy of the touch is less perfectly understood, than that of either of the other senses. The cause of this has most probably arisen from the number of sensations, as heat, cold, weight, dryness, moisture, anxiety, itching, hunger, thirst, pleasure, pain, roughness and smoothness, which have been, with what propriety, we shall not stop to inquire, attributed to it. In regard to most of these sensations, there is very likely, a special modification of structure adapted to the perception of each of them. As all animals, from man in whom it is the most perfect, down to the polypus, possess this sense in a greater or less degree, it may be deemed the universal sense. By means of it, we become first acquainted with bodies extraneous to ourselves, and it is indeed the only one which convinces us of the actual existence of the external world. As extraneous matters may come in contact with every part of the surface of our bodies, for weal or for woe, so every portion of that surface has been endowed with the sense of feeling;* but in man,

* "The touch distributed over the whole surface, appears to be the elementary sense; and all the others are only modifications of it, accommodated to certain properties of bodies."—*Richerand.*

This view of Richerand's is certainly in accordance with the beautiful simplicity of nature, and is very likely to be true, the necessary modifications being added to the original ground-work. Although the touch has been termed the geometrical sense, it is notwithstanding now and then liable to err.

as in animals, some parts of it are more sensitive, and better fitted than others, to make us acquainted with surrounding objects. They are, therefore, better adapted to the purposes of intellection, and may on that account, be more appropriately considered as the organs to which this sense has been particularly allotted: as the hand, for instance, and also the lips and tip of the tongue. From the readiness and facility, with which the eye and ear are employed in the investigation of things, the sense of touch, which is the corrector, and in fact, the most important of all the senses, has been comparatively neglected, and consequently, its education overlooked; but the success which has attended modern attempts to improve the mental condition of the blind, and accounts of the perfection to which the sense of touch has been brought in more than one instance, establish the fact, that it is susceptible of the highest degree of improvement by culture. Notwithstanding this neglect, man, so far as his own faculties are concerned, is indebted to this sense for his sublime station at the head of this sublunary creation: for we find in looking through the whole range of animated nature, that the place assigned to the several tribes of animals is elevated in proportion to the degree with which they have been endowed with this sense.

The other senses are all prompted to action by the properties of matter, and of those only do they take cognizance: but the sense of touch makes us acquainted with matter itself. The hearing has to do with the undulations or vibrations of matter; the smell, with its odors; the taste, with its flavors, and some of its chemical properties; the eye with its properties by which light is reflected;* but the touch being conversant with matter itself, is not only less liable to mistakes; but is, as has been hinted, the corrector of all its congeners. It is truly the geometrical sense, and gives us results with mathematical precision, so long as its functions

* It is not yet settled among philosophers whether light is a mere property of matter, or an absolute body; a luminiferous ether.

are confined to properties indicating the occupancy of space, as length, breadth, &c., which are perhaps, in strict construction, its legitimate objects. In the performance of this, its most appropriate function, it should be recollected that this sense like the others, is connected with certain muscles, upon whose contraction, its accuracy depends, and that this muscular contraction, as in the other senses, is the basis upon which every educational effort must depend for success. To this proposition, there is one apparent exception, which is not, however, without analogy. The subcutaneous substance is of a middle nature between the cellular tissue, and muscular fibre, and consequently, has a degree of contractility, intermediate between that belonging to those structures, and hence, the power of judging of the figure and size of bodies which are merely pressed against the person, without motion either in them, or the part of the body in contact with them.* In this connection, we may mention that there are certain other portions of the surface of the human body, covering the erectile tissues which are endowed with an highly sublimated and peculiar modification of the sense of touch; but this, being of a voluptuous character, does not seem to be very well fitted to enlarge the boundaries of knowledge, or increase the mental powers.

This modification, was considered by Buffon, as a sixth sense.

Most animals, and perhaps all, have parts better adapted to the exercise of this sense than others; in man, the lips,

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* It is owing to the shrinking or shrivelling of this subcutaneous substance, and also perhaps partly to the shrinking and wrinkled state of the skin itself, which may be indeed only the result of the above-mentioned causes, that the touch is rendered obtuse in old people, and also in emaciated subjects. This shrinking and shrivelling of the skin constitute the first indications of the approach of old age, and of signs of decay and decrepitude from that cause. In most cases they may be postponed, and the life prolonged several years, by the timely and frequent use of the warm, or what is better, the vapor bath, which causes a relaxation of the capillaries of the surface, and counteracts the effects above-mentioned. The writer is indebted to Darwin for this suggestion. Based on animal physiology, its correctness cannot be questioned.

tip of the tongue, and the hand, more particularly the ends of the fingers, are the parts which possess the touch in its most exalted degree. The exaltation of the touch in these parts, is owing partly to their being more copiously supplied with vessels circulating red blood, and partly to the arrangement of their papillæ; which, together with their connection with numerous muscles of volition, constitute their greater fitness to be employed as the instruments of this sense. It should be kept in mind, and therefore it is so often repeated, that this connection of the senses with the voluntary muscles, forms the basis upon which, according to our theory, all educational efforts must mainly depend. Perhaps it would be no great exaggeration, were we to say, that the improvement of this sense as an organ of intellect, by education, results almost exclusively, from the employment of those muscles. Haller defines touch to be that sense which takes cognizance of resistance alone. In the present connection, we purpose to confine its function to that resistance, which bodies composing the external world, make to parts of our bodies pressed against them by the action of our own muscles. In this sense only, is the faculty of touch susceptible of improvement by education, because when brought by this means in contact with surrounding objects, it is under the control of the will, and is thus employed for the purpose of acquiring knowledge. In this view of the subject, it must be admitted that the perceptions by this sense are of a very limited character; but they are not liable to the errors which pertain to those of the sight and hearing, which so often extend their researches into the vast fields of illimitable space. The relation which touch has to sight, has given rise to much discussion among the learned; and it is still a controverted question, whether our ideas of distance, extension, and figure, are gained by touch alone; but we think that enough was said while treating of the education of the eye and ear, and especially that of the former, to convince any candid person that both these senses are in fact capable of taking ample cognizance of these properties of matter, and that the

eye is indeed the organ most commonly employed in judging of extension, figure, and distance.

The process for the education of this sense is analogous to that of the sense of hearing, and in fact, of all the other senses. On account of the greater facility with which the eye takes cognizance of matter subjected to its inspection, it should be covered in all our attempts at improvement of the other organs of sense. This hint has probably been derived from the fact familiar to all, that the other senses, and especially those of hearing and touch, are so much improved when the sight is lost. Let the pupil then be hoodwinked, and try to distinguish different metals, wood, and persons, by the feel: then endeavor to denominate pieces of coins, &c. In doing this, the different degrees of temperature should be regarded; because the sensations in this respect, depend on the powers of conducting caloric which is peculiar to each metal. If the sensations of heat and cold are to be regarded as belonging to the touch, the rule of judging of them is quite independent of muscular action.*

These sensations are chiefly confined to parts of the body obnoxious to the vicissitudes of temperature, the physical causes producing them; and as the agencies of these causes, if much increased or diminished, might be attended with very injurious consequences the sensations they produce are designed to preserve us, by a timely intimation that certain changes are going on in parts exposed, incompatible with the due performance of function or even with the continuance of organization.

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* It has been contended that a different set of nerves have been provided for the perception of the sensations of heat and cold; but we think the nerves, like the capillaries, are precisely the same in all parts of the body, and that their peculiar perceptive faculties and functions arise from the peculiar tissues with which they are surrounded, and which so modify their common sensibility as to enable them to experience and transmit to the sensorium this or that feeling; and that they are from the same causes, and in like manner, qualified for different perceptions.

Relaxation or contraction of the capillaries constitutes the physical changes which give rise to the sensations of heat and cold; and it should be remembered that these sensations, as has been suggested, may be produced by those states of the vessels independent of their physical causes, i. e. the addition or abstraction of caloric. The degree of sensation indicates the degree of contraction or relaxation, rather than the intensity of the physical cause.

OF DIMENSION, EXTENSION, DISTANCE, &C.

These are the legitimate objects to be regarded in the education of the touch. The pupil blindfolded should be made to pass his finger, hand, or foot, over a graduated measure, and note how much certain muscles must be made to contract in order to carry the member over, or along a certain space. In this way the properties of space may be judged of after considerable experience, with wonderful accuracy. Mathematical figures, solid or superficial, should be made the subjects of experiment. In the same way the relative size and position of things, may be ascertained. I knew a young gentleman, blind either from birth, or very early infancy, who subsequently attended medical lectures; became a good anatomist, and as I was informed, passed a satisfactory examination, and received his degree in due form. Whether he ever attempted to practice his profession I have not had the means of knowing.*

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* This young gentleman attended three courses of my lectures on anatomy. When lecturing on osteology, I always took care to put the several bones upon which I was discoursing into his hands, and soon had the pleasure to find that he was following me in the demonstration by passing the hand over the several parts which were being described. He was also in the habit of coming to the table and examining the subject, and tracing out in the same manner the muscles, blood-vessels, and various other soft parts, as the viscera, &c. &c. In the daily class examinations, he made much fewer mistakes than was to have been expected. I was particularly struck with the accuracy of his knowledge of the relative situation of parts, and took great pleasure and pains to assist him in educating sense of touch. I recollect his coming into my lecture room one evening, when Dr. Gridley rather jocosely said to him, "Demming, tell us

The young gentleman above alluded to was able to distinguish many colors by the feel, but was unable to explain to me the principles upon which his judgments were formed.

OF WEIGHT.

It is very questionable whether gravity has any relation to the sense of touch. In our opinion, it more particularly respects the muscles, or rather the degree of force with which they must contract, in order to raise a body from the ground, or to remove it from the place in which it stands. In either of these cases, trials should be made upon bodies, whose weight has been previously ascertained: our standard weights, for instance. When the degree of contraction has been noted again and again, or with a sufficient number of repetitions to give the pupil a standard within himself, the experiment may be extended to other bodies.

PLEASURE AND PAIN.

These sensations have been, as suggested in a former part of this paper, attributed to the sense of touch; but very erroneously so in the opinion of the writer. Every part, every tissue of the body as well as the organs proper to the senses, may be the seat of pain. This sensation is always owing to an over-contracted, or an over-distended state of the capillaries of the part in which it is located. If those vessels be constricted, or inordinately contracted, pain is experienced: if only slightly constricted, the sensation will be uneasiness, rather than decided positive pain. Suppose 3 to indicate

whether the room is lighted or not." After a moment's pause he replied, "Rather badly lighted, sir, only two lamps burning." "True," says the doctor, "but how do you know it? How do you know that there are two lamps, or any lamps at all? May there not be a candle or two?" "I know," replied Demming, "there are two lights, and that they are lamps, by the crackling which they make in burning, which is different from that made by the burning of candles." Neither the Doctor nor myself could hear the crackling of which he spake with so much confidence. This showed that the education of another sense had not been negeleted.

the state of distention which is natural to these vessels, and consequently, that in which no sensation whatever is experienced: then suppose a cause of an irritating nature to be applied to their inner surfaces which stimulates them to contract down to 2, uneasiness will be felt; if it stimulate still more, and cause the vessels to contract to 1, pain will be experienced; and we shall be prompted to seek relief; if the contraction be still greater, the pain will be more violent, and the vessels will, from their vehement efforts to contract, lose their vitality: in other words, they will contract until they die. On the other hand, taking 3 as before, for the natural standard of fullness, if the vessels be distended to 4, there will be as in the case of moderate contraction, uneasiness; if to 5, pain; the vessels will resist painfully, if to 6, or upward, the pain will be violent, because the vessels resist forcibly, painfully; and will soon lose their vitality as sometimes happens in neglected, mal-treated, or intense inflammation. In the former case, the pain from over-contraction will be attended with a shrinking or diminution of the size of the part; and if many vessels be involved in the affection, or if its seat be in an important organ, the vessels of the skin will do what the vessels of the part affected do, i. e. contract or shrink (and this is what we always mean by organic sympathy; when we say that one part sympathizes with another, we mean that it, as a whole, or that its vessels do what the part primarily affected, or its vessels do,) and a sense of chilliness will be experienced.

Pain from over-contraction, is relieved by whatever induces the vessels to relax, as fomentations, warm bath, friction, opium, &c. Examples of pain from this cause are exhibited in chronic rheumatism, in the cold stage of intermittents, and in various other analogous diseases. Pain from cold or the abstraction of caloric is of this kind. The other variety of pain, which arises from an over-distended state of the vessels, in which they are not only put upon the stretch, but are stimulated to resist painfully, is relieved by

the abstraction of fluids, &c., and also by narcotics, which, by lessening the sensibility of the vessels, prevent their feeling impulses from within, and induce them to forego their resistance, and relax; but in order to make this relief permanent, the activity and force of the heart must be considerably abated, otherwise the vessels which have been induced to relax or to forego their resistance, will again be fully distended, and we shall soon have them again put upon the stretch; the consequence of which, will be violent resistance, and a renewal of the pain. Examples of this kind of pain are to be found in inflammation, acute rheumatism, tonic gout, &c., &c. The nerves, which are distributed to, and preside over the organs of organic life, as the stomach, bowels, glands, and the capillaries of nutrition throughout the whole system, have ganglia placed upon them, which intercept and prevent the transmission to the sensorium of sensations pertaining to organic life, so long as they are consistent with the healthy performance of function. Of course, those sensations never reach the mind until that contingency ceases, and actions incompatible with the regular and due performance of function begin; but when such actions, as interfere with, and derange the function, or endanger the structure of organs or parts do begin, then, as the nerve itself is continued on through the ganglions to the brain or spinal marrow, changes will take place in the brain or sensorium commune, which will awaken consciousness in the mind: until this happens, the structures and tissues pertaining to organic life, cannot be considered as organs of sense; as has been intimated, that they might be. The perception of these changes is unpleasant, or painful, and prompts us to desire and seek relief, but it is not (although the cause of intelligence,) calculated, except, so far as the means of relief are concerned, to enlarge the field of knowledge, or augment intellectual power.

But not so with the five senses. On their nerves, no ganglia are placed; there is, therefore, no interference with the transmission of intelligence of the changes which are going

on in them.* Their appropriate and peculiar stimuli produce changes, which it may be, and most probably are,

* To this doctrine, an objection might be raised, from the fact that ganglia are placed on the posterior fasciculi of all the spinal and some of the cerebral nerves which are, by common consent, admitted to be nerves of sensation, and particularly subservient to the sense of touch; upon a little reflection, however, it will be obvious that this is not only not repugnant to, but in perfect accordance with our doctrine;—that it should be so, if that doctrine be true. These posterior fasciculi not only render the parts to which they are distributed sensitive, but transmit to the organ of mind the perception of those changes which constitute sensation. Now then, as circulation, secretion, nutrition, and functions of organic life, are going on in the parts to which these fasciculi are sent, as well as the other actions and changes, it is necessary that ganglia should be placed on them, or that some other arrangement should exist by which the perception of those changes belonging to organic life should be interrupted and utterly prevented, so long as they are consistent with health. Again, it might be urged that changes peculiar to organic action are perpetually going on in parts to which the nerves exclusively appropriated to the other senses, as sight, hearing, taste and smell, as well as to touch, are sent, and that therefore ganglia should have been placed upon them for the reasons already assigned; but it should be recollected that these very changes are wrought by vessels which are supplied by nerves from the gangliac system, and that the nerves peculiar to any sense are not required to take cognizance of them. This, it is believed, is a full answer to these objections. The importance of this subject, perhaps, warrants a further consideration. Mechanical distention, which is alternately applied and withdrawn, is the natural stimulus, which prompts the capillaries of organic life, to which the gangliac system is appropriated, to act; and the nerves of this system take cognizance of the state of those vessels only, which respects their contraction or dilatation, constriction or relaxation, and especially so when either is abnormal. The senses of taste and smell are excited by the chemical properties of matter, the sense of hearing simply by its undulations, vibrations, or oscillations, and the sense of sight by a property of matter, as some suppose, which is termed light, or as others think by a luminiferous ether. In neither of these cases is it known that the appropriate stimuli in their ordinary action effect the capacity of the vessels connected with the organic actions of those senses; and if they did, as they may, and perhaps sometimes do, when acting intensely or with more than their usual power, the nerves which belong to the gangliac system would take cognizance of these irregularities. If the capillaries were stimulated to action by any irritating qualities in the fluids which they circulate, they would, according to the law already glanced at, lose their susceptibility for that particular impression; for the fluids containing the irritating quality are always present, and therefore would be always in contact with the inner surfaces of the vessels; the necessary consequence of such a contingency would be the derangement of function, and ultimately a change of structure and organization. Organic disease would follow.

mere contractions or relaxations, modified by the structure peculiar to the organ, which are perceived and transmitted to the brain by the nerves adapted by the same peculiarity of structure for this or that peculiar function, and of course, can do nothing else. If these changes produced in the organs of sense, be mere contractions or dilatations, modified by the peculiarity of structure, then they will, as the one or the other prevails, be attended with pleasure or pain, which will also be perceived by the nerve at the same time that the change itself is perceived. If the contraction, or relaxation be no more than ordinary, there will be neither pleasure nor pain, and consequently, no emotion will accompany the perception of change effected in the organ, by the object which is acting upon it; the result will be, that of simple cognition; but if the contraction or relaxation be more than common, pleasure or pain will certainly accompany the perception of change, and the idea will be pleasurable or painful, and instantly followed by desire or aversion. The pains and pleasures of sense are, like knowledge, produced directly or indirectly by objects exterior to the body, (all of which have a greater or less tendency to produce them,) and are realized by that sense only whose adaptedness fits it to acquire the knowledge of the entity whose properties are calculated to call that sense into action. For instance, the pleasure derived from colors, can be experienced only through the medium of the sight, the sense from which alone, we derive our knowledge of color. It should not, however, be forgotten that the same feelings may arise from the mere action of the capillaries of the sense in the entire absence of their appropriate physical causes. Feelings produced in this way, belong to the imagination, and constitute its pleasures and its pains. If contraction or relaxation of the capillaries beyond the ordinary degree be the physical cause of pleasure or of pain in the senses, then it follows that every entity has a tendency to produce these feelings in the sense upon which they are fitted to operate. If I bring up to my recollection, a land-

scape or prospect which I have examined; or a scene through which I have passed, the several senses which were called into activity by the objects which at first operated on them will again become active and perform the same actions, and the same ideas will be produced and be accompanied by the same feelings. In all such cases the effect is the necessary result of experience. In regard to the feelings belonging to this class, which are ever disposed to transcend reality, prudence would seem to dictate that we should always endeavor to compare those which refer to the past or the future, with those actually experienced or realized, in order to prevent our being exercised with an undue degree of regret for such as have been lost, or disappointment when we enter upon the enjoyment of those which have been in prospect. In the contingency mentioned, the pleasure or pain is as much the necessary result as the conception of the object or any of its properties; but it should be remarked that the intensity of the feeling, as well as the vividness of the idea, may be increased by the attention voluntarily exerted. The principles upon which this fact depends have already been enumerated and explained. As attention is under the control of the will; as feelings with nine-tenths of the world become motives to action; as all agencies acting upon the body, and especially upon the senses, have the power of modifying the actions which they excite; and as there are properties in every agent which are fitted to produce pleasurable or painful feelings, the pupil should early be taught in all cases to fix his attention as much as possible upon those of the first class; by which procedure, his feelings and consequent conduct will be such, as greatly to promote his own happiness, and that of those about him. It is owing to the neglect of this rule, that so many persons find something in almost everything to cavil at; an infirmity, exceedingly prevalent in our own country; with the English, it is quite national; especially, if anything French, be the subject of consideration. Let the pupil be taught ever to look upon the "bright side."

Right feeling, and right acting, depend upon right thinking; and right thinking, upon right education; which, is therefore, inseparably connected with the hopes and happiness of man, for time and eternity; and also with his country's weal, her woe, her glory. The best educated men, I mean in the broadest acceptation of the term, will be the best and most efficient men. They will be the men of power, and the men in power; the rulers of the nations; the sovereigns of the world! KNOWLEDGE IS POWER!

If this, then, be so, the philanthropist and the patriot must feel with solemn concern, the importance of having the principles of education, rightly and thoroughly understood, and judiciously carried out in practice. This nation, composed of sovereign states, with their own separate governments, and embracing a vast extent of territory, with almost every variety of climate, soil and production, has consequently, so many, and such diverse interests, that apart from the form of its government, it can hardly be said, to possess "that unity of sentiment and interest, which makes men feel, and act as one social body," and which constitutes nationality. The writer would therefore suggest, for the consideration of the citizens of this great republic, that measures be taken for devising and establishing a system of education with "the BIBLE, without note or comment," for one of its elementary books, which may concentrate the feelings and affections of the people, promote "the reign of mild peace" among ourselves, and the nations of the earth, and give character and perpetuity to our own glorious UNION and its INSTITUTIONS.

APPENDIX.

The mind during our waking hours, and also perhaps during sleep, is continually engaged in some active mode of thinking, and this fact, of which none will doubt, goes to establish the analogy between the brain as the organ of mind and other organs, as the liver or salivary glands, which go on forming bile or saliva all the while, whether we will or not; in like manner the brain goes on forming ideas, whether we will or not. This may be termed spontaneous thinking, and is attended with no effort of the will, and is of course without fatigue. Whether we shall think or not, is no more optional than it is whether bile or saliva shall be secreted. The brain forms ideas just as the liver forms bile, and with no more effort; but by fixing the attention, (i. e. the immediate direction of the mind,) upon an entity, the brain spontaneously forms ideas of it. This may be termed one species of voluntary thinking, and is very easily performed, and therefore attended with little or no fatigue. It is undoubtedly the mode pursued by all great thinkers. One of our most profound statesmen, whose gigantic intellect towers above all others in the land, when once questioned concerning his mode of investigating subjects by which he was led to such stupendous results, replied that he only placed the subject before him, and watched the workings of his own mind in relation to it. This was to him mere spontaneous thinking; the only voluntary effort required or employed was simply that of fixing and keeping the mind directed to, or in other words, the attention fixed upon the subject, which cost at the most but little comparative effort. In the case above alluded to, it required scarcely an effort, it having been the habit of the distinguished individual. Now, the attention is generally under the control of the will; but sometimes it is not, and therefore when a subject greatly interests us, we cannot, for the reason just assigned, help thinking of it. The attention is fixed upon it, and the brain keeps forming ideas concerning it.* It is still the spontaneous mode of thinking under the control of the attention, or in company

* Hold an object before the mind; concentrate the thoughts upon it; and soon it will glow, or at least become luminous.

with it, and may be of little use, for unless strictly watched, the mind will go on forming the same ideas, (i e. thinking in a circle,) of the subject which is thus kept before it. To prevent this, a stronger effort of the will must be invoked, and the capillary vessels of the brain compelled to perform new actions, that the views of the intellect may be extended; in many instances originality of thought will be the result. Reasoning from analogy, we should infer that the process of thinking, like the secretion of bile, is carried on during sleep; but in a manner of which we are quite as unconscious as we are of secretion, or of any other function of organic life. Ganglia are placed upon the nerves going to the liver, (and also to all other parts connected with the functions of organic life,)[§] upon whose influence the secretion of bile depends; by which anatomical arrangement all consciousness of such an operation in the liver, even in our waking hours, is prevented; but another method of preventing the consciousness of cerebral action during sleep, has been devised by the all-wise Maker of our bodies. The better to understand this subject, we must take a brief physiological view of the phenomena of sleep, the final end of which is, the repose of the system by suspending all its voluntary powers, mental and corporeal. When sleep is perfect, all consciousness both in regard to the actions of the body and of external agencies is lost, consequently all, except such as belong to organic life, (of which, when normal, the individual is likewise unconscious,) cease to be carried on, and the whole system is reduced to a condition analogous to that which is peculiarly appropriated to organic life. The question which we propose mainly to consider, is, the nature of the cause of sleep, and the manner in which it operates to induce that state. The cause, we think, is a certain degree of pressure, or perhaps more properly speaking, compression of the medullary substance of the brain. This doctrine that sleep is caused by the compression of the medullary or parenchymatous substance of the brain, we shall now endeavor to prove, and then proceed to show in what way that effect is produced.

1. It is a well known fact that mechanical pressure, whether from extravasated fluids, or from other causes, with which the surgeon is more particularly conversant, is capable of destroying

all consciousness, and inducing a lethargic state of the gravest character.

2. The sense of fulness about the forehead and eyebrows; the flush of the cheeks and redness of the eyes, clearly betoken that an increased quantity of blood has been received into those parts, and as the brain and its meninges, parts within the scull, receive their blood from the same vessels as the parts without, the inference is fully warranted that this increased determination of blood to the head obtains as well in the internal as in the external parts, in which the signs of it are so conspicuous. Without addueing other arguments, as this point will probably be conceded, we shall proceed to inquire how this increased flow of blood to the brain is produced. That it is not occasioned by an increased action of the heart, is clear, from the fact that during sleep the pulse is slower and weaker than it is when we are awake; if, then, it be not attributable to an increased activity of that organ, it will follow, as a necessary consequence, that relaxation of the capillaries of the face and brain is the cause to which we must look for an explanation of the phenomena of sleep. This view of the case is fully justified by the phenomena themselves; the conjunctiva becomes red; the cheeks flushed; a sense of fulness about the forehead and eyebrows is experienced; the muscles of the face and neck relax, and presently the eyes close; the mouth opens, and the head rests upon the chest, and finally, if there be no mechanical impediments, the whole body falls prostrate; phenomena exhibiting a state of relaxation not only of the capillaries of the brain, but of the whole muscular system connected with voluntary motion.* The recumbent posture assumed

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* This is in full accordance with a law of the system, alluded to in this paper, which is, that increased contraction or resistance is sooner or later followed by a spontaneous relaxation which is usually proportionate with the previous contraction. If the vessels of the brain have been made to labor with unwonted energy in voluntary efforts, intellectual or corporeal, the relaxation which spontaneously follows will be commensurate and the sleep proportionally profound.

Again, I would remark that this state of relaxation, on the approach of sleep, is attended with pleasure, either as a cause or an effect, and this fact, (i. e the connection of pleasure with relaxation,) which has been dwelt upon and explained when another part of our subject was under consideration, goes far to corroborate the position which has been taken.

by the body, is, that which is, philosophically considered, the most favorable for repose, as well as for the complete turgescence of the vessels of the brain, and without which, sleep is seldom profound, or completely refreshing. We may further remark that the effect is not confined, as is too generally supposed, to the voluntary powers; but is extended to the functions of organic life; therefore, respiration, as well as circulation is diminished, and digestion, secretion, and indeed all the functions of organic life are carried on during sleep with less energy; and the whole body may be truly said to rest.

By the recumbent posture, the gravity of the blood is taken off, and thus the labor of the heart is lessened, and the vessels of the brain will continue to be distended until resistance to further distension is excited, which will be increased not in the vessels of the brain only, but in other parts of the body also, until it either forces the blood out of the capillaries of the brain, and thus relieves that organ to a certain degree of its compression; or until the resistance becomes painful, and in either case there will be a partial renewal of consciousness, and the sleeper will dream; or if the resistance of the small vessels should change to positive and vigorous contraction, the compressing cause will be removed, and with its removal the slumbers of the individual will cease, and the vessels of the brain resume their wonted action, and that organ its ordinary function of thought. If the sleep, however, has been protracted and profound, a sense of heaviness in the head and lassitude of body will be experienced, which will continue for some time before the brain and other organs under its control will take on their accustomed activity. Dreaming and somnolence (and perhaps insanity) are nothing more nor less than the spontaneous thinking of which we have been speaking, attended with a consciousness which varies in degree at different times, and under different circumstances, but which is always below that of the waking state, therefore, the greater the consciousness, short of complete wakefulness, the more vivid will be the dream, and the more likely to be remembered. If the person dreaming have consciousness enough, and a sufficient control of the will to make the vessels of the brain iterate the actions which took place while dreaming, or in other words, think the dream over again, he will be quite sure to remember it; but if he neglects to do this, he will

most assuredly be unable to recollect it, and the more especially so, if he fall asleep after having dreamed. People seldom dream at the commencement of sleep, or if they do, the dreams are not often remembered for the reasons above assigned. Although we have no control over the succession of ideas in dreaming, and in some cases it must be confessed, the connection is quite unaccountable, yet I doubt not that ordinarily the same laws of association obtain in regard to the sequence of thought in that state as in other modes of thinking, to wit: "resemblance or analogy; opposition or contrast; contiguity, or nearness of time and place; cause and effect; premises and consequences;"* all of which may be modified by the disposition and habits of thinking peculiar to each individual. Upon this principle I have very often been able to explain my own and the dreams of others.† The senses do not all fall asleep at once, but in succession. Those of smell, taste, and in fact that of the touch taken in its most extended sense, are so slightly connected with volition that we need scarcely regard them in connection with sleep, except to say that they are the first to come under its influence: the next in order is the sight, and lastly the hearing: and in the transition from sleeping to waking, the order is reversed; the sense of hearing is first awakened, then sight, and lastly, touch, smell, and taste. The faculty of speech is never called into action, unless the sense of hearing is to a certain degree awake: hence it is, that you may for the time being, hold conversation with most sleep-talkers. With some, the hearing is so dull that it is necessary to speak to them in a louder tone, which may be done without the risk of waking them, and not unfrequently it is also necessary to repeat questions in order to commence or keep up the colloquy. When persons talk in their sleep we are made acquainted with the spontaneous thinking which occupies their minds. This sleep-talking affords very satisfactory evidence of the activity of the mind during sleep. Without it we should have been obliged in our present state of physiological knowledge, to have depended mainly on the evidence

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* Hedge's Logic.

† In this connection the dreams of Joseph; of Pharaoh, his butler and baker, and of Nebuchadnezzar, may be considered with interest. May not indeed the interpretation of dreams depend upon the same principles of association?

furnished by analogy, for without the exercise of the will (which is the very essence of voluntarity, and which is suspended when sleep is complete) in some small degree, the process of spontaneous thinking would be imperceptible, at least the evidence of it would be very imperfect, and dubious. As the will is the faculty of the mind, most closely associated with the external senses, it is of course the first to yield which it does in about the same proportion as it is affiliated to the senses which, as we have seen are more or less readily affected by the approach of sleep; hence, as the hearing becomes more and more awake, the individual is in the same proportion more and more disposed to talk, and as the waking of that sense increases, the locomotive organs, which require from the will a much stronger impulse, are put in motion and the sleep-talker becomes a sleep-walker; hence somnambulism. The author is fully aware of the difficulty of proving that thinking goes on when we are asleep as well as when we are awake; but the fact that many persons who have been blind for a great number of years continue to dream of visible objects, goes very far in addition to what has been said to settle the question in the affirmative.* In such cases it is the action of the capillaries at the origin of the optic nerve (or in other words, the spontaneous thinking of visible objects, exactly analogous to what it would have been, if the person had not been blind or asleep and was looking at the objects of which he was dreaming) which produces the ideas peculiar to vision. In fact, the feelings may be and often are excited by internal causes alone, as has been shown. A person in sleep may feel as if he, himself was bound down by force, or his arms may be crossed, and he may dream that they are so held by another; and moreover the images of the persons performing these disagreeable acts may be distinctly formed. In these cases, and in numerous others which might be mentioned, the afferent nerves whose office it is to make the sensorium acquainted with the state of the centrifugal organs, especially those of locomotion, convey to it intelligence, or excite in it a consciousness of the condition of the muscles thus circumstanced, while the brain is not sufficiently awake to produce the necessary change in the efferent nerves to

* This fact may be of some practical consequence, as it shows that the optic nerve has not lost its power.

cause the muscles of the arms to act, and alter the position of these spell-bound members, although the desire to do so may be awakened, and finally so much increased as to become intense and painful, just as any other vehement desire ungratified causes pain. Now pain, like all other disagreable impressions produces contraction, and in this case it causes it in the capillary vessels of the brain, and of the spinal marrow, at the origin of the nerves which go to the muscles of the arms, and what takes place there, likewise takes place at the other, the peripheral extremity of the nerves, and consequently in the capillaries of the muscles; and what all the vessels of a single muscle (or of a number) do, the same will the muscle or muscles do;—that is, contract and move the limbs, and with the movement of them, the night-mare also ceases*. It might be not only amusing, but instructive, and perhaps useful to trace out the analogy which the writer thinks exists between spontaneous thinking, dreaming, and insanity. It might suggest hints relative to the treatment of that malady.

The education of the muscles having been omitted as a distinct topic, the writer would barely suggest, that to the mechanic, it is a subject of grave import. Every apprentice, while learning his trade, especially, if it be one of light labour, should be taught and urged to work fast, and soon he will acquire the habit of doing so: of working all the while as if upon a wager; and he will then do it with as much ease and as little fatigue as if he worked to the "TUNE OF OLD HUNDRED." Thus learned, he will accomplish nearly twice as much; consequently, be twice as useful; do twice the good, and be more valuable in the community than any two drones, and may expect a double reward. Let this method of learning trades be adopted, and soon we shall have few mechanics of the old school; and *they* will be far in the back ground.

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* The foregoing explains the reason why night-mare, although very distressing, is not dangerous

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THOUGHTS

ON THE CONNECTION

OF

LIFE, MIND, AND MATTER,

IN

RESPECT TO EDUCATION.

BY J. P. BATCHELDER, M. D.

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